Introduction

This volume presents e study of 'persons with degrees or equivelent quelificetions in engineering, technology end science' in Greet 8ritein from 1959 to 1968. For brevity, such qualified people are referred to as QSEs. Full definitions and the list of qualifications end subjects included are given in Pert Four.

It should be emphasized at the outset thet there are a number of ways in which the deta aveilable can be combined. The quality of the deta incorporated veries from source to source and there are considerable weeknesses in some of the component series. On most points the constraints of internal consistency narrow the choice, but frequantly e considerable element of judgement has been used. Another combination of methods may not necessarily produce exectly the same picture. Therefore it is considered valueble that both the methodology used in this study and the resultant series should be set out in detail for those interested in the subject.

Part One contains cherts and summary tables which have been designed to illustrate the patterns of estimated stock and employment of QSEs and tha chenges which have taken place between 1959 end 1968. In interpreting the numbers it should be borne in mind that, since all the basic dete are subject to sampling error, corresponding errors are associated with the overall series. It is also possible that, while the overall series eppear to be reasoneble, there may be compensating errors in the component series.

Part Two describes the methods used to estimete the most likely values for total stock of QSEs in Great 8ritain for the years 1959 to 1968. The estimetes for 1961 and 1966 ere obteined from the results of the Censuses of Populetion, taking into account the bias-correction factors prepered by the Office of Population Censuses and Surveys (see Appendix). The ennual changes of total stock are built up from new supply (Section 2), allowences for migration (Section 3) and deaths (Section 4). Section 5 presents the resulting estimated changes in total stock end Sections 6 and 7 describe the assessment of numbers out of employment end of activity rates. At this point the link is made with the estimates of numbers of QSEs in employment derived in Part Three. The two series are brought together in the essessment of activity rates.

Part Three describes the methods which have been used to derive estimates of numbers of QSEs in employment, incorporating data from the Censuses of Population and the manpower surveys. The census figures used are those for 1961 end 1966 : the survey figures ara those collected from employers every three years since 1956, the most recent being in Januery 1968. (Full details of methodology and the results for 1968 are given in Part Four.) The full picture is built up in stages, sector by sector.

Manufecturing is the first sector for which estimetes are made and results from the manpower surveys are aligned with census results using the analysis by industry from the Censuses of Populetion. This establishes six points of measurement for 1959, 1961, 1962, 1965, 1986 and 1968. Problems arise from the fact that the two component series have different coverege and are subject to sempling errors. They do not readily form a smooth combinad series and either may be adjusted to make e better fit. A method was tried out which assumes a linear trend in the ratio between the two for the period 1961 to 1966 and the most likely extrepolation backward to 1959 and forward to 1968. Since this method, epplied to the whole of manufacturing, gives a smooth series without further adjustment of census data, this series has been accepted and the estimates for individual industries ara adjusted to fit into this total (Section 9).

A similer method is then epplied to construction end nationalized industries (Section 10). The census points for other sectors are teken without further edjustment. This decision is supported by the experience in those sectors in which survey observations are elso aveilable.

Methods devised for sectors involving public employers are discussed in Section 10. For sectors of employment in which only two points are available from the Censuses of Population, the method developed in the generalized total stock model is applied to give estimates of tha values for 1959, 1962, 1965 and 1968 (Section 11).

Then at the end of Section 12, the estimates for QSEs in employment are releted to the estimates of economically active stock (Table 43). As mentioned above, et the end of Part Two, Section 7, these estimates of economically active stock are considered in terms of activity rates, defined es the proportion of economically active stock to total stock. 'Activity rates' of QSEs depend mainly upon factore

which are independent of the actual number of QSEs in stock—for example, their age, the proportion of women in total stock and probably, in some way which is not yet defined, the activity rates of the whole population. The latter may influence such considerations as early or late retirement or re-entry to employment of married women.

The content of Part Four is of a different nature. It provides an account of the methodology used in the menpower survey in Jenuary 1968. The raw data from the survey are given in full and are tebled with similar data from the 1965 and 1962 surveys. The report on the 1965 survey, published in 1966, was prepered by the Committee on Manpower Resources for Science and Technology who also initiated the 1968 survey. In particular the late Lord Jackson of Burnley, who was Chairman of the Committee on Manpower Resources from 1964 to 1968, gave his full support to the most recent survey and mada valuable suggestions at both tha planning and analytical stages.

Part one
Charts and summary tables

Introduction

The statistical series summarized and illustrated in Part One are taken from the work described in the volume. Reference is made to the relevant tables from which the data are taken.

The estimates for the total stock of QSEs and of gains and losses given in Tables 1 to 4 come from the work described in Part Two.

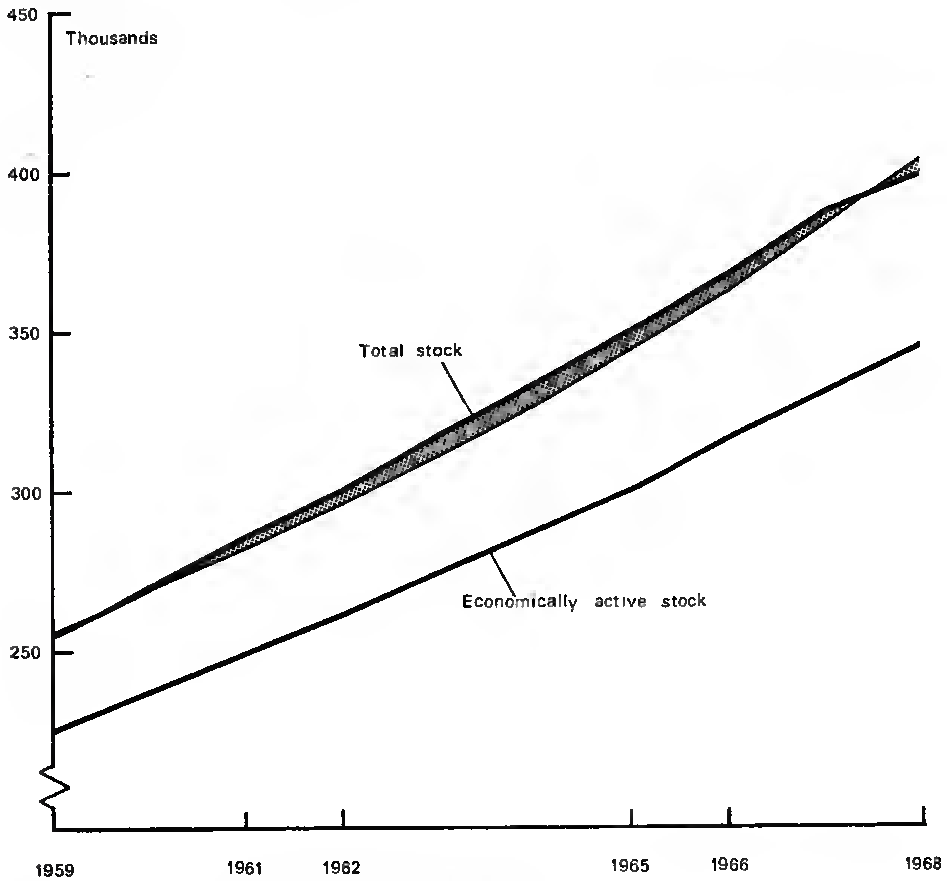
The estimates of QSEs *in employment*, found on pages 10 to 13 are derived from Part Three. The charts and Tables 8, 9, 13, 14 and 15 illustrate data taken directly from the 1968 manpower survey which are given in full in Part Four. The definition of industry groups in terms of SIC 1958 is given in the Appendix page 133.

Note. Because of rounding, the percentages shown in the tables in this volume may not always add to 100·0

Total stock of QSEs 1959 to 1968

The chart below shows estimates of tha total stock of persons in Greet 8ritain holding qualifications in engineering, technology and science (QSEs), rising from 255 300 in 1959 to 403 000 in 1968; a growth of nearly 60 per cent in this period. Figures relate to 1 January.

The lightly sheded area shows the effect of net migration on total stock; this contributes a net increment to stock from 1959 to 1966 and a decrement in 1967 end 1968 (Tables 18 to 23).



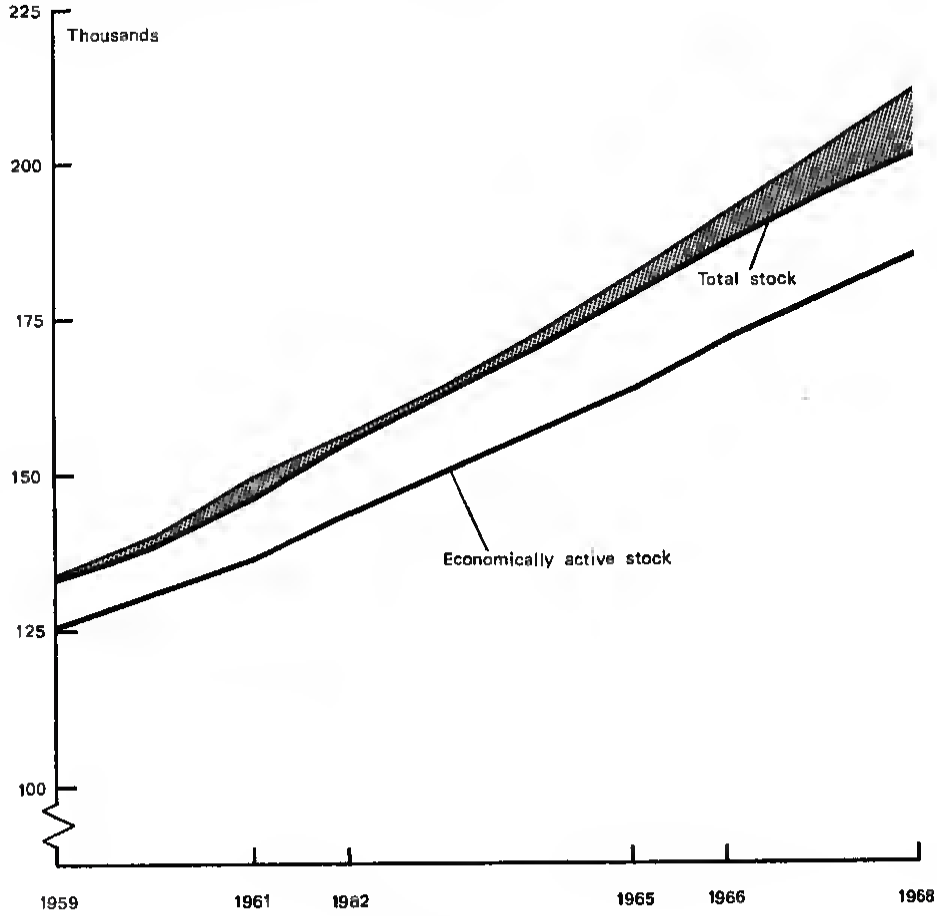
Thousands

Table 1	Total stock	Economically active stock	Inactive stock
1959	266·3	225·5	29 8
1961	283·7	248·7	35·0
1962	299·9	261·7	38·2
1966	348·1	301·3	46·8
1966	367·3	317·6	49·7
1968	403·0	347·8	56·2

●See also Table 36.

Total stock: Engineering and technology 1959 to 1968

QSEs holding qualifications in engineering and technology amount to one-half of the total stock in 1968: this represents a slight fall in proportion from 52 per cent in 1959. The chart above shows a growth in total of 52 per cent from 1959 to 1968. It will be seen from the lightly shaded area that there was a decrement due to net migration throughout this period.

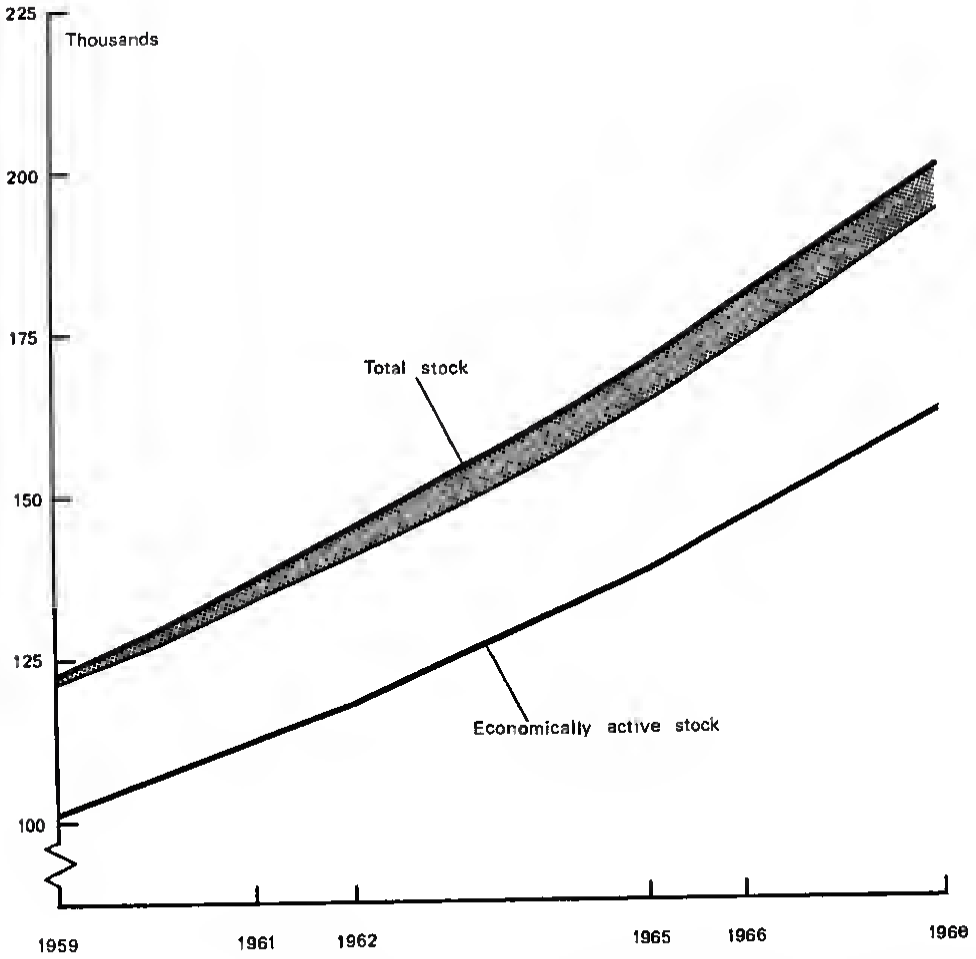


Thousands

Table 2	Total stock	Economically active stock
1959	133·2	125·1
1961	146·9	135·9
1962	155·6	144·1
1965	176·3	163·5
1966	167·3	171·7
1968	201·9	185·2

● See also Table 36

Total stock: Science 1959 to 1968



Thousands

Table 3	Total stock	Economically active stock
1959	122·2	100·4
1961	136·8	111·8
1962	144·4	117·6
1965	169·8	137·8
1966	180·0	145·9
1968	201·0	162·6

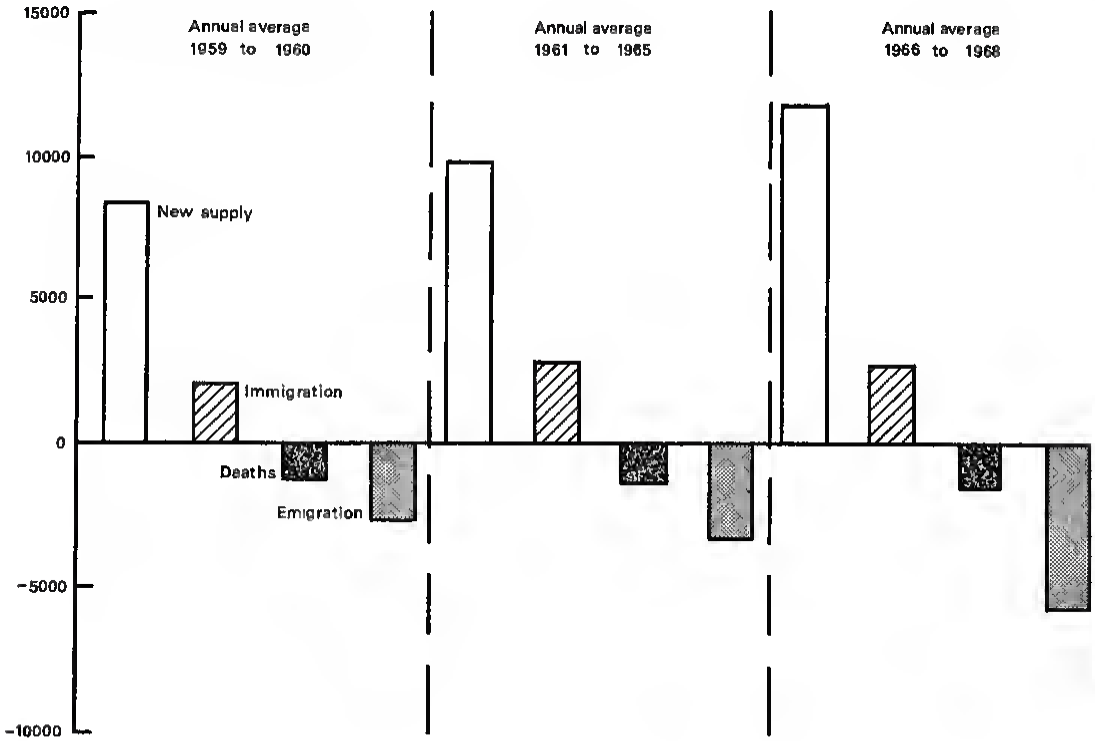
●See also Table 36.

One-half (201 000) of the total stock of QSEs held quelifications in science in 1968 (48 per cent in 1959). The chart above shows a growth of nearly 65 per cent in the period 1959 to 1968: the increment due to net migration is shown es a lightly shaded area.

Gains and losses of total stock of QSEs

The hietograms below illustrate the reletive sizes of gains and losses over the nine-year perlod. The estimates are *averages* for the two pre-census years, the intercensal period and the two post-census years. The figures in Teble 4 show thet immigration end deaths have changed relatlvely little. But considerable increases have been recorded in new supply end emigration for both subject groups.

Engineering and tachnology

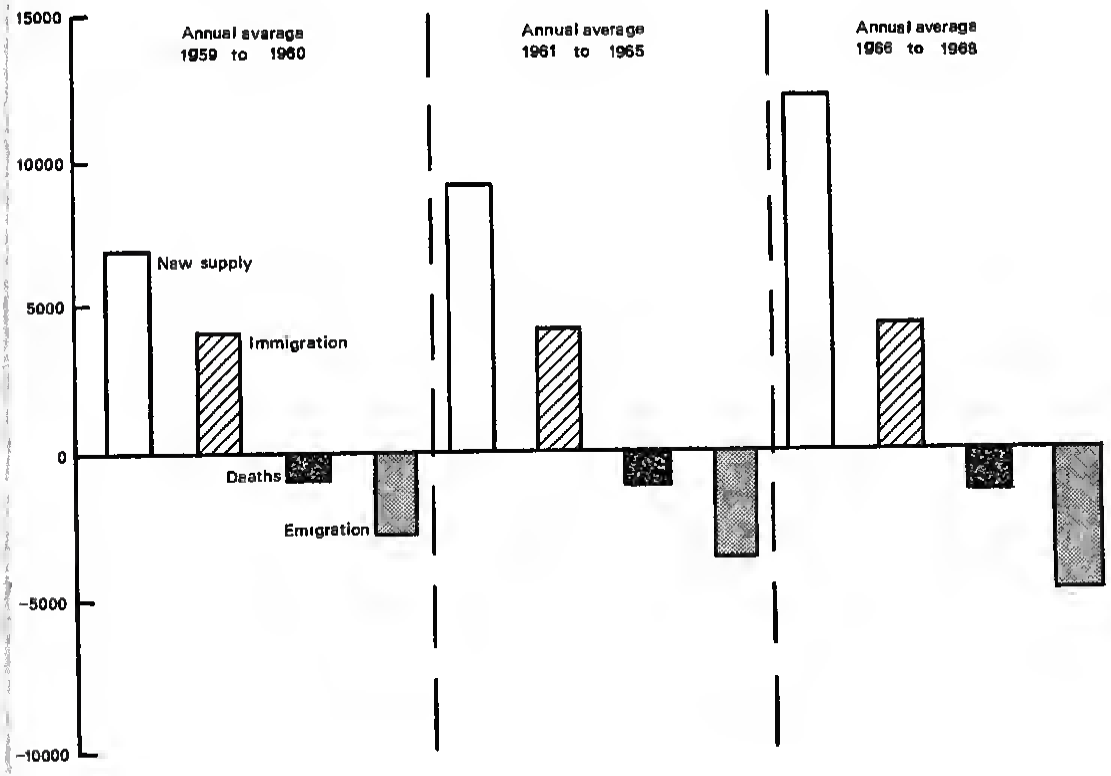


Annual average of flows in each period

Table 4	Gains		Losses	
	New supply	Immigration	Deaths	Emigration
Engineering and technology				
1959 and 1960	6 470	2 065	1 130	2 630
1961 to 1965	9 660	2 790	1 395	3 205
1966 and 1967	12 060	2 600	1 630	5 720
Science				
1959 and 1960	6 960	4 020	905	2 775
1961 to 1965	9 070	4 265	1 130	3 570
1966 and 1967	12 050	4 440	1 290	4 680

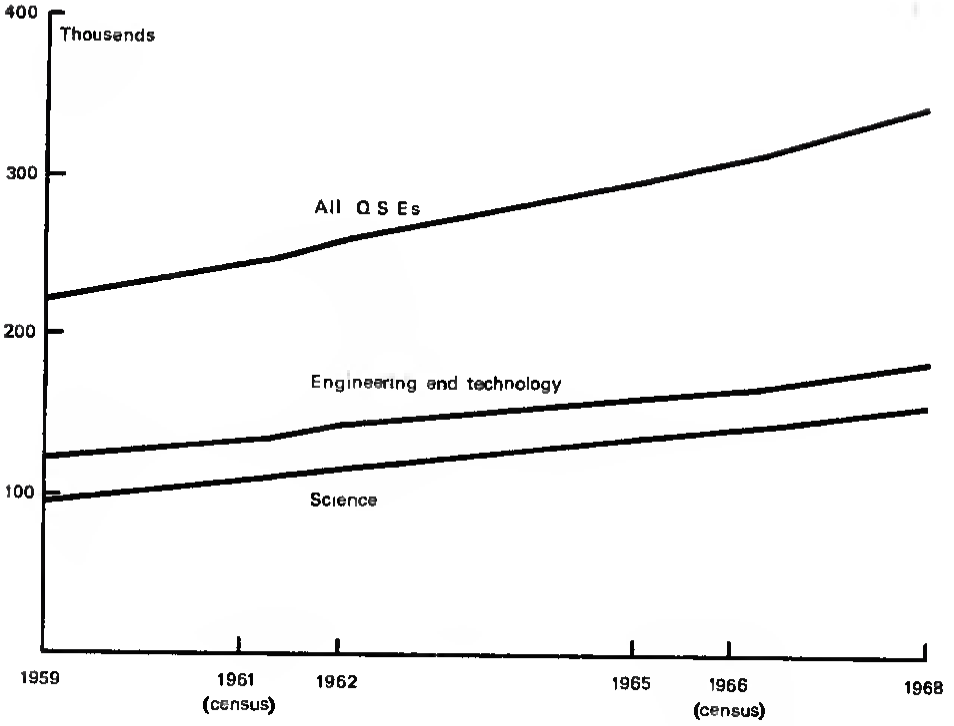
●See also Table 28

Science



All QSEs in employment 1959 to 1968

It is estimated that there were 341 900 QSEs in employment in Great Britain in 1968. This is compared with 222 100 in 1959. As a proportion of the employed work force, QSEs had risen from 0·93 per cent in 1959 (1·0 per cent in 1961) to 1·38 per cent in 1968.



Thousands

Table 5	All QSEs	Engineering and technology	Science
1959	222·1	123·2	98·9
1961	248·3	135·6	110·7
1962	258·0	142·2	115·9
1965	296·6	160·9	135·6
1966	312·0	168·6	143·4
1968	341·9	183·1	158·8

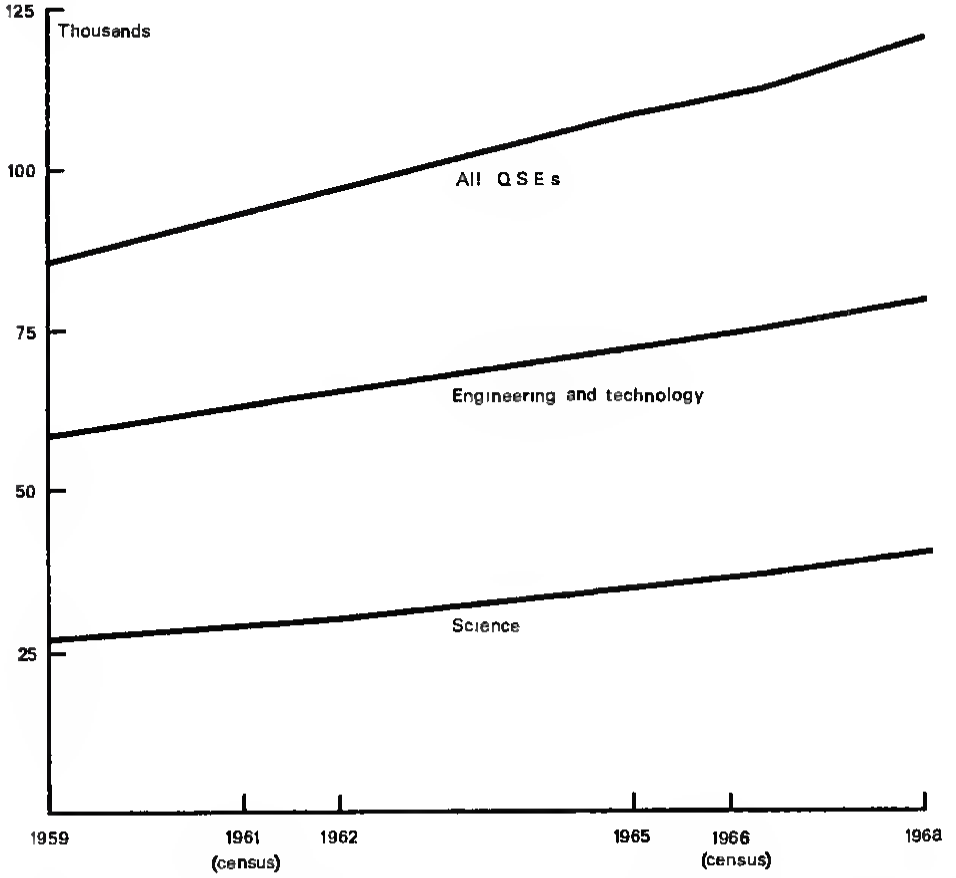
●See also Table 40.

QSEs in manufacturing 1959 to 1968

In 1968 it is estimated that 120 400 or 35 par cent of all QSEs in employment were in manufacturing. In the period 1959 to 1968 the numbers had risen by 41 per cent, e rate of 3·9 per cent per year since 1959.

During the same period the density (QSEs per 100 persons employed) hed risen from 1·00 in 1959 to 1·38 in 1968 (see Table 44).

Two-thirds of the QSEs employed in manufecturing in 1968 held qualifications in engineering and technology. This is equivalent to 44 per cent of all QSEs in employment with these qualifications.



Thousands

Table 6	1959	1961 Census	1962	1966	1966 Census	1968
All QSEs	85·6	94·2	97·0	107·8	112·7	120·4
Engineering end technology	68·1	64·1	66·6	72·4	75·6	80·0
Science	27·5	30·0	30·6	35·6	37·3	40·4

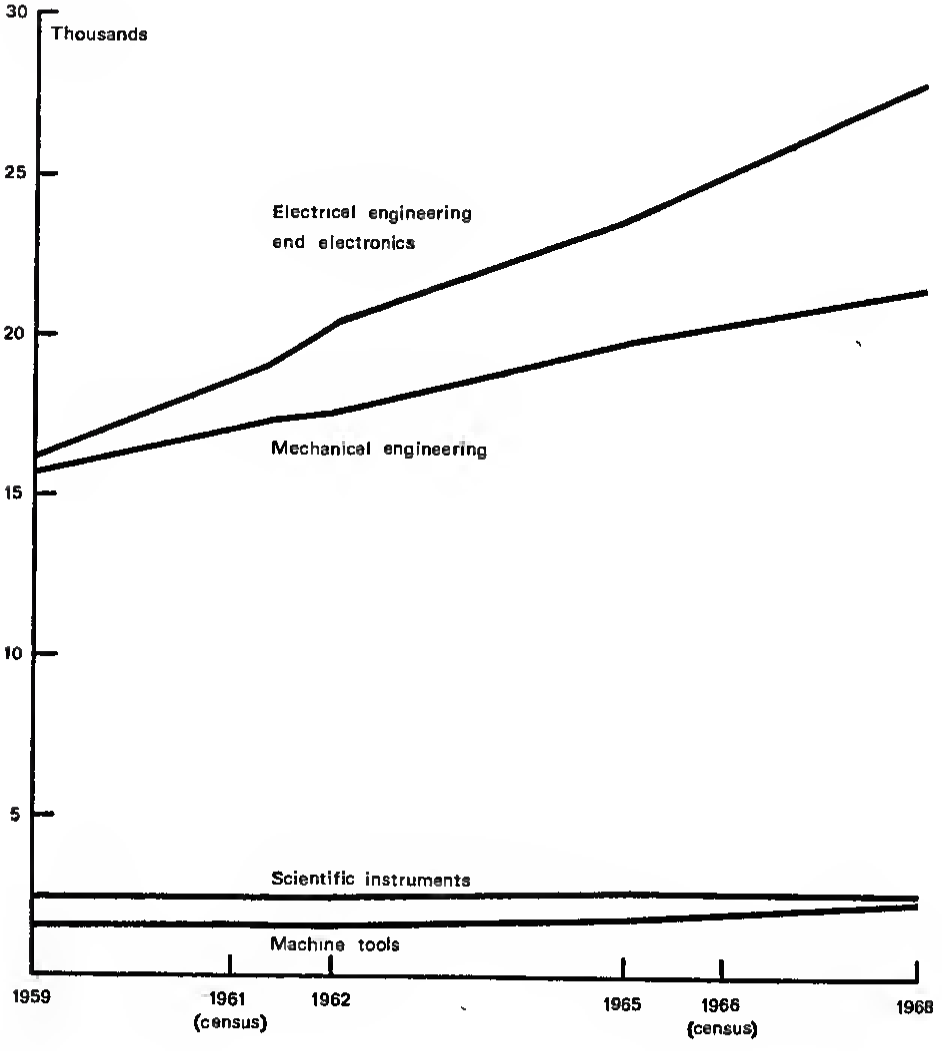
● See also Table 39.

Employment of QSEs in engineering, chemicals and vehicles

In 1968, it is estimated that 27 770 QSEs were employed in electrical engineering and electronics compared with 21 495 in other mechanical engineering and 23 565 in chemicals end allied industries.

In the nine yeers 1959 to 1968, the largest increase, 71 per cent, was in electricel engineering and electronics.

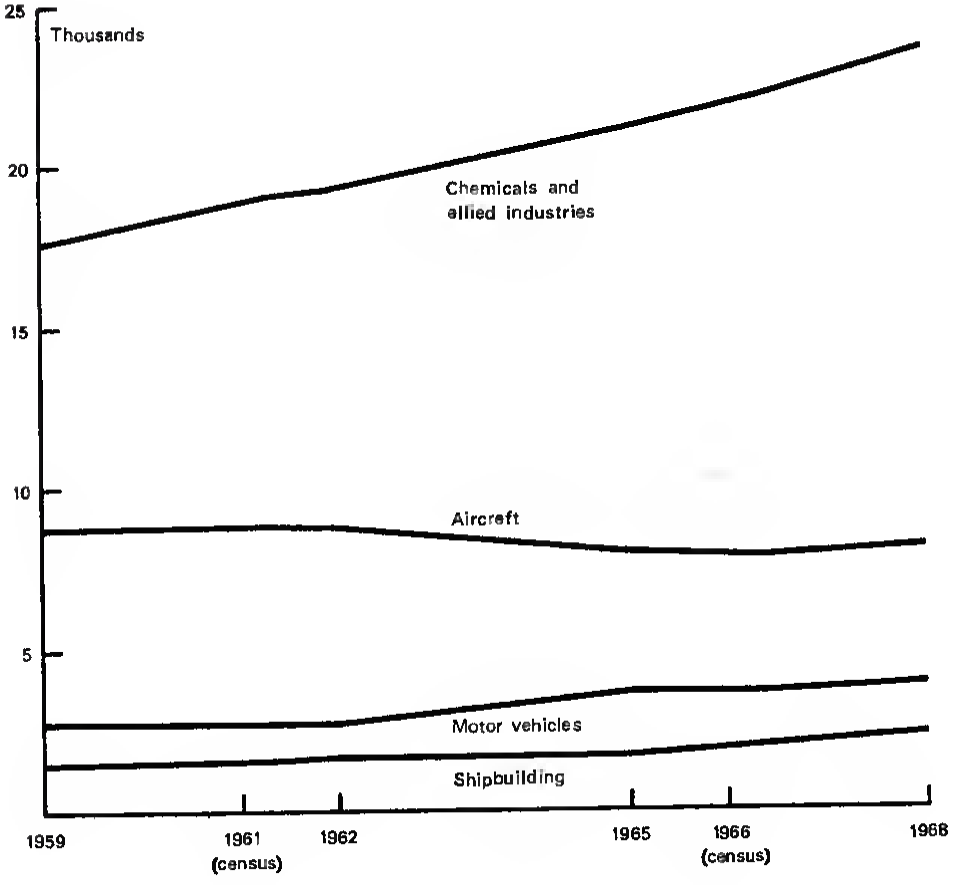
This compares with 36 per cent in other mechanical engineering and 34 per cent in chemicals. The number of QSEs employed in aircraft fell during the period.



Thousands

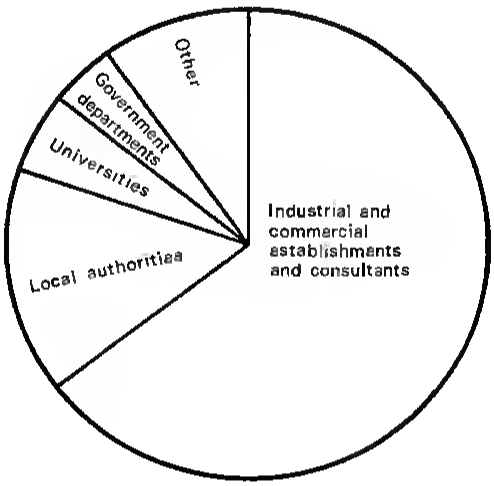
Table 7	1959	1961 census	1962	1965	1966 census	1968
Electrical engineering and electronics	16·2	19·1	20·4	23·7	25·5	27·8
Machine tools	1·5	1·6	1·6	1·8	2·2	2·5
Scientific instruments	2·5	2·5	2·5	2·7	2·7	2·7
Other mechanical engineering	15·6	17·4	17·7	19·8	20·8	21·5
Chemicals and allied industries	17·7	19·1	19·4	21·2	22·1	23·6
Aircraft	8·9	6·9	8·6	8·0	7·9	8·1
Motor vehicles	2·9	2·8	2·8	3·7	3·7	3·9
Shipbuilding and marine engineering	1·8	1·6	1·7	1·7	2·0	2·3

●See also Table 39.



Type of employer 1968

All subjects



In 1968, the public services—central and local Government, UKAEA, the Armed Forces, nationalized industry and public corporations—employed just over 30 per cent of all QSEs; universities had e further 5·5 per cent.

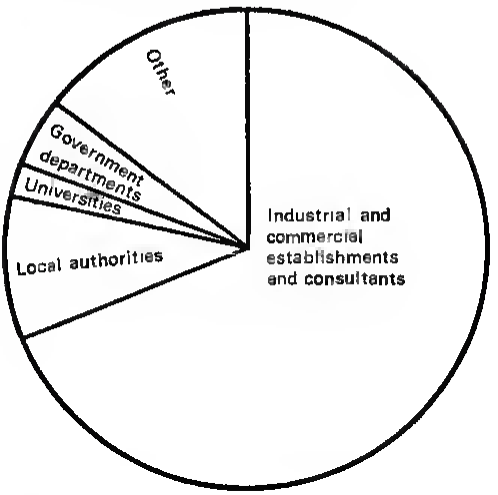
The remaining 64·4 per cent were either self-employed, or were privately employed by industrial or commerciel firms end consultants. This compares with 63·6 in 1966.

Table 8	Thousands	*Per cent*	
		1968	*1965*
All employers	341·9	*100·0*	*100·0*
Industrial and commercial establishments and consultants*	220·1	*64·4*	*63·6*
Nationalized industries	22·4	*6·6*	*6·5*
Government departments	15·0	*4·4*	*5·4*
Research councils	2·9	*0·8*	*0 6*
Armed Forces	4·7	*1·4*	*1·5*
UKAEA	4·7	*1·4*	*1·7*
Local authorities (including schools and establishments of further education)	53·4	*15·6*	*16·0*
Universities	18·7	*5·5*	*4·7*

●See also Tables S1 to S15 in Part Four

*Including self-employed.

Engineering and technology



Science

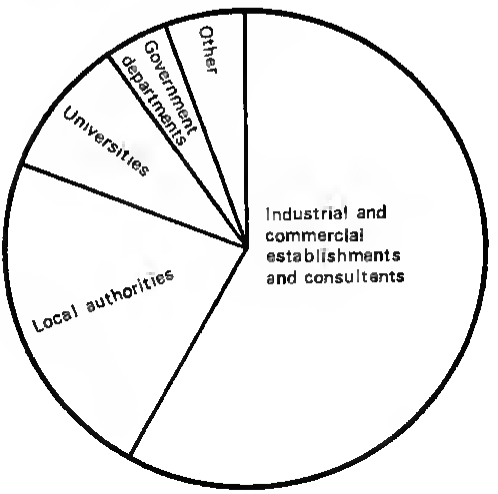
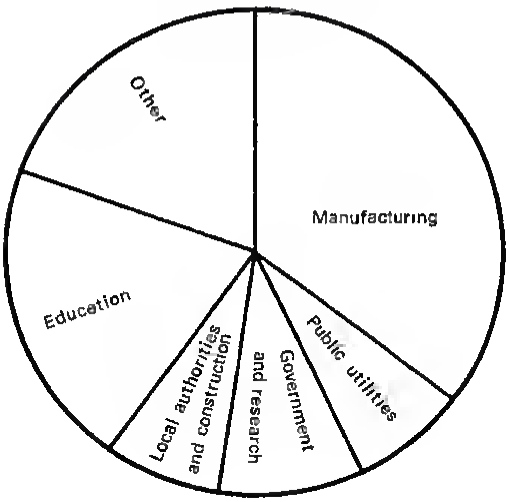


Table 9	Engineering and technology		Science	
	Thousands	*Per cent*	Thousands	*Per cent*
All employers	183·1	*100·0*	158·8	*100·0*
Industrial and commercial establishments and consultants*	127·1	*69·4*	93·1	*58·6*
Nationalized industries	19·8	*10·8*	2·6	*1·6*
Government departments	8·2	*4·5*	6·8	*4·3*
Research councils	0·3	*0·2*	2·7	*1·7*
Armed Forces	3·6	*2·0*	1·1	*0·7*
UKAEA	2·5	*1·4*	2·1	*1·3*
Local authorities (including schools and establishments of further education)	17·6	*9·6*	35·7	*22·5*
Universities	4·0	*2·2*	14·7	*9·3*

* Including self-employed.

Field of employment 1968

All subjects

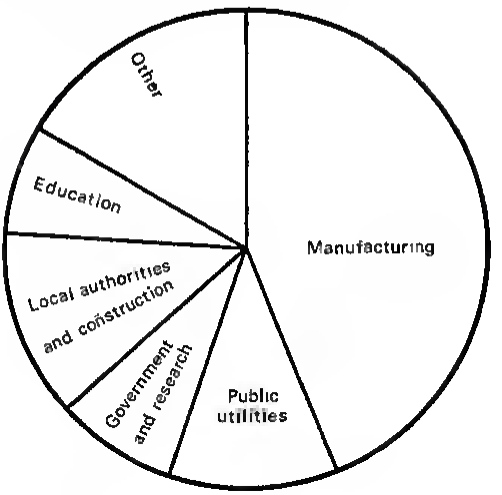


In 1968, 120 400 or 35·2 per cent of all OSEs were located in the menufacturing sector. The next largest groups were in education services, 71 100 or 20·8 per cent, followed by Government and reseerch 9·5 per cent.

Tabla 19	Thoueands	*Per cent*
Total	341·9	*100·0*
Menufecturing	120·4	*35·2*
Government end research	32·6	*9·5*
Local authorities end construction	25·4	*7·4*
Scientific and technical services	10·9	*3·2*
Public utilitres	25·1	*7·3*
Mining and querrying	3·9	*1·1*
Agriculture	3·5	*1·0*
Eduction	71·1	*20·8*
Commerce	10·9	*3·2*
Accounting end legal eervices	1·4	*0·4*
Medicel servicee	10·4	*3·0*
Other	26·2	*7.7*

●See also Tables 40 and 41.

Engineering and technology



Science

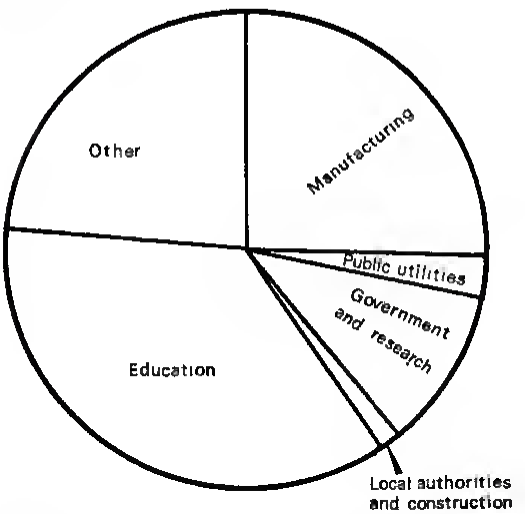


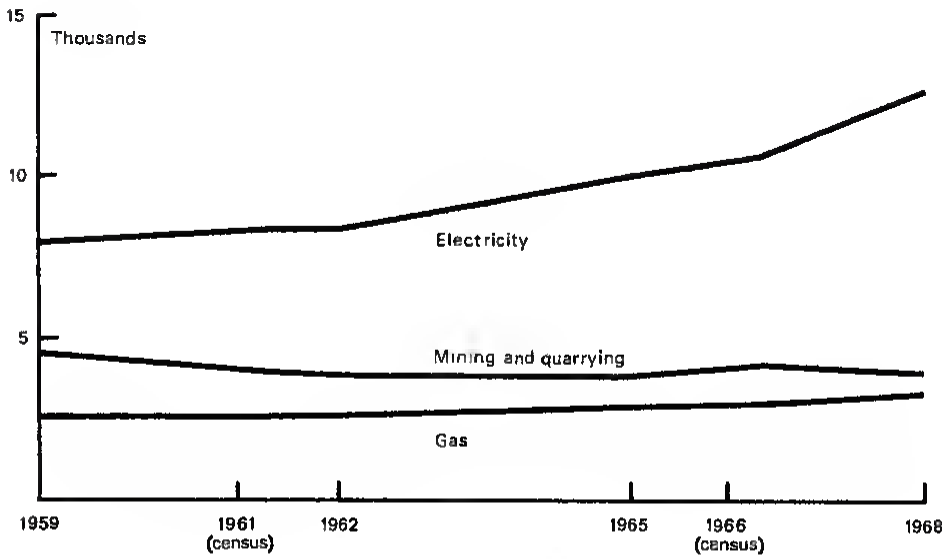
Table 11	Engineering and technology		Science	
	Thousands	*Per cent*	Thousands	*Per cent*
Total	183·1	*100·0*	158·8	*100·0*
Manufacturing	80·0	*43·7*	40·4	*25·4*
Government and research	15·2	*8·3*	17·4	*11·0*
Local authorities and construction	23·2	*12·7*	2·2	*1·4*
Scientific and technical services	9·4	*5·2*	1·5	*0·9*
Public utilities	21·2	*11·5*	4·0	*2·5*
Mining and quarrying	3·3	*1·8*	0·6	*0·4*
Agriculture	0·7	*0·4*	2·7	*1·7*
Education	13·5	*7·4*	57·6	*36·3*
Commerce	5·8	*3·2*	6·2	*3·3*
Accounting and legal services	0·4	*0·2*	1·0	*0·5*
Medical services	0·7	*0·4*	9·7	*6·1*
Other	9·6	*5·3*	16·5	*10·4*

● See also Tables 40 and 41

QSEs in electricity, gas and mining and quarrying 1959 to 1968

In this sector the growth of QSE employment has been largely in electricity generation and distribution, nearly 60 per cent in the nine years. In contrast, employment in the gas industry rose by 25 per cent.

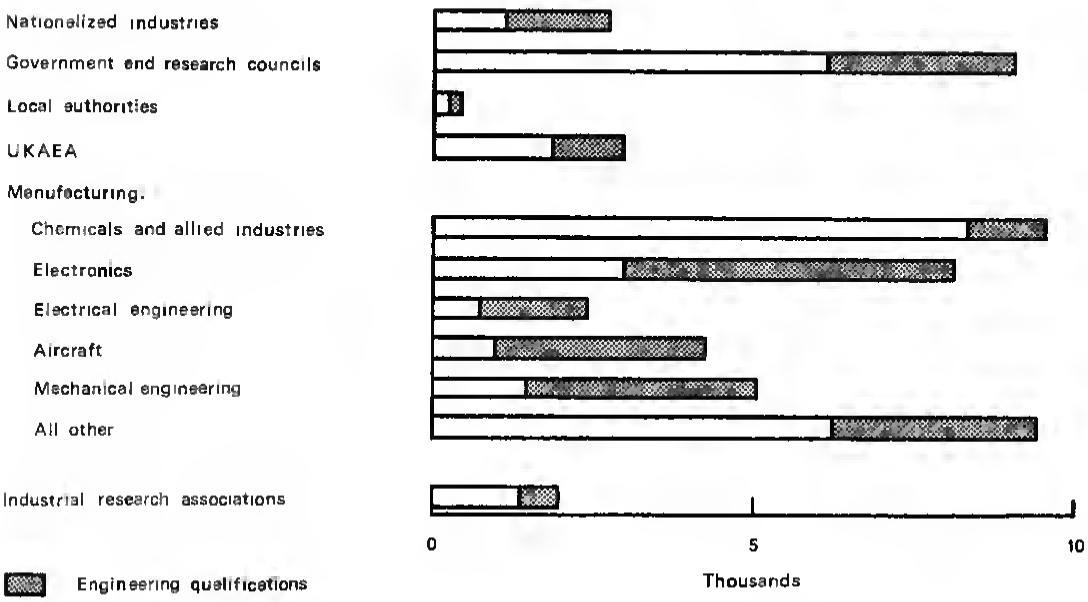
Employment of QSEs fell in mining and quarrying. In 1965 the fell wes checked by a widening of the membership of the Institution of Mining Engineers. Without this change of coverage, employment would have been about 3 300 in 1965 and 3 400 in 1968.



Thousands

Table 12	1959	1961 census	1962	1965	1966 census	1968
Electricity	7·9	8·3	8·4	10·0	10·6	12·8
Gas	2·6	2·6	2·6	2·9	3·0	3·3
Mining and quarrying	4·6	4·0	3·8	3·8	4·2	3·9

Research and development survey 1968



Thousands

Table 13	All QSEs in survey		Engineering	
	All functions	R & D	All functions	R & D
Nationalized industries	22·4	2·8	19·5	1·6
Government and research councils	17·9	9·1	8·1	2·9
Local authorities	11·7	0·4	10·7	0·2
UKAEA	4·7	3·0	2·3	1·1
Manufacturing:				
Total	111·3	38·9	84·4	17·8
Chemicals and allied industries	22·4	9·5	8·3	1·1
Electronics	16·4	8·1	10·7	5·0
Electrical engineering	8·5	2·5	7·1	1·7
Aircraft	7·2	4·3	5·7	3·3
Mechanical engineering	23·3	5·1	19·5	3·5
All other	33·4	9·4	15·1	3·1
Industrial research associations	2·2	2·0	0·7	0·6

●See also Tables S2 and S6 in Part Four.

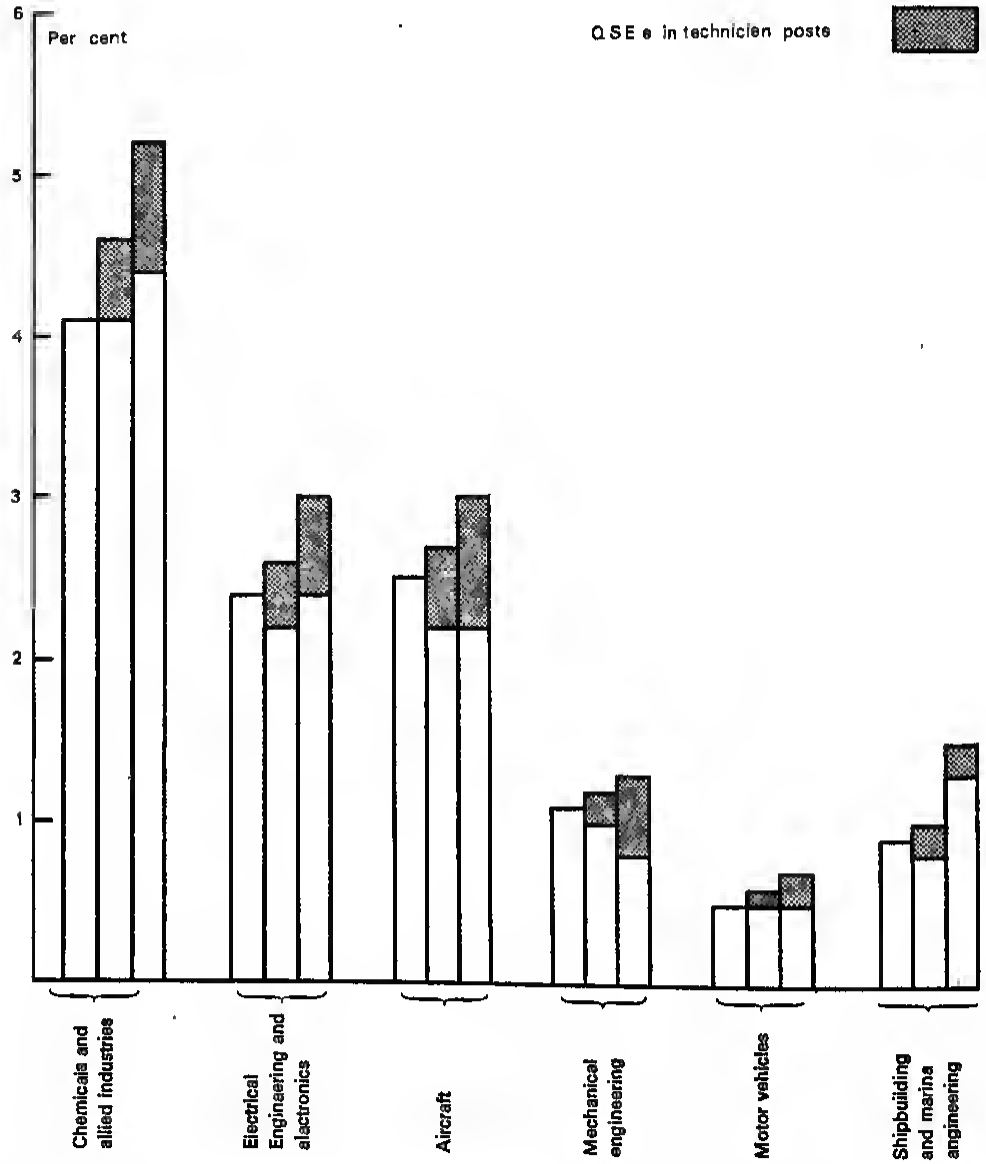
Density of QSEs in surveys 1962, 1965 and 1968

The density of QSEs is shown for the three survey years, 1982, 1965 and 1968. The chemicals industry has the highest density, 5·2 per cent in 1968; electrical engineering and electronics and aircraft both have 3 per cent.

Per cent

Table 14	*1962*	*1965*	*1968*
Chemicals and allied industries	*4·1*	*4·6*	*5·2*
Electrical engineering and electronics	*2·4*	*2·6*	*3·0*
Aircraft	*2·5*	*2·7*	*3·0*
Mechanical engineering	*1·1*	*1·2*	*1·3*
Motor vehicles	*0·5*	*0·5*	*0·7*
Shipbuilding and marine engineering	*0·9*	*1·0*	*1·5*

● See also Table S3 in Part Four.



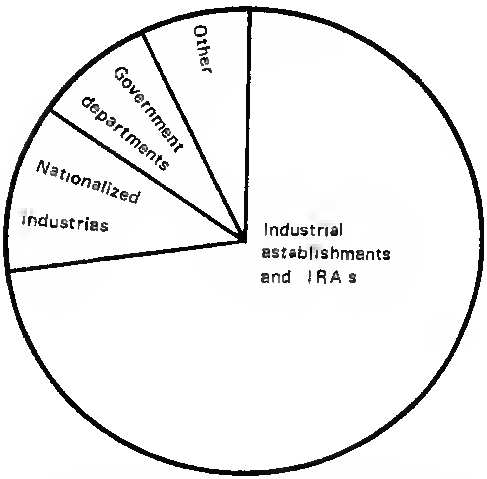
Persons working as technicians or technical supporting staff in 1968

In addition to giving information on all persons holding degree and equivalent qualifications in engineering, technology and science, employers were also asked to give an analysis of persons *working as technicians or other technical supporting staff*. Inclusion in this group of persons was exclusively defined by the *type of work performed*, although an analysis by type of qualification was also requested (see Table B of questionnaire).

The question on technicians was included for the first time in the 1965 survey. Comparable data for the two surveys are given in Tables S16 to S27 of Part Four.

The full definition is given in Part B of 'Definitions' accompanying the questionnaire. These are reproduced in Part Four.

Technicians or technical supporting staff survey 1968



63 per cent of all technicians were in manufacturing, and over 40 per cent are employed in the engineering industries, including vehicles and shipbuilding.

6 per cent of persons in technician posts held a degree or equivalent qualification and 20 per cent had an HND/HNC or equivalent qualification.

Thousands

Table 15

	All technicians	Qualifications held				
		Degrees etc.	HNC HND	Tech. certificate	ONC/ OND	Other or none
All employers in survey	**720·8**	**43·1**	**82·8**	**52·0**	**82·8**	**449·8**
Industrial establishments and industrial research associations	518·2	29·9	69·6	35·1	64·3	319·3
Nationalized industries	83·8	6·3	10·6	6·3	6·8	53·8
Government departments	56·2	3·4	6·9	4·7	7·0	34·2
Research councils	4·7	0·7	0·4	0·3	0·3	2·9
UKAEA	8·8	1·1	1·4	0·3	1·0	3·2
Local authorities (including schools and establishments of further education)	33·8	0·9	3·0	3·0	2·4	24·6
Universities	17·1	0·8	1·0	2·3	1·1	11·9

●See also Table S18

Part two
Stock and flows

Stock and flows

1 Introduction and definitions

1·1 Estimates of total numbers or stock of QSEs in Graat Britein ara obtained from the Cansusas of Population in 1961 end 1966. A technical nota is given in the Appendix, Section 20; two points only ere made here. One is that the estimetas for 1961 used in this study are derived, not from the tables published in 1962[1] but from later anelyses which differ in detail from the earlier version. (The differences eriae from some re-codings made during post-publicetion editing.) The second point is that certain bias-correction factors prepared for 1961 and 1966 by tha Offica of Population Censuses and Surveys hava been taken into eccount; the method adopted is described in Saction 20.

1·2 Taking the two points for 1961 and 1966 a mathod has been developed to estimate the most likely valuas for total stock in tha years from 1959 to 196B. The basic assumption is that the diffarence betwaen tha two census points sets an uppar limit on the cumulative growth between April 19B1 and April 1966. Within this constraint new supply and wastage from deaths end retirement have been estimated; net migretion has been taken es the residual. Thus a cartain amount of judgament has been used in deciding upon the balance between the migration flows, as the data in this area ara incomplete. It follows thet the values for years outsida these limits, 1959, 19B0 end 1967, 196B are influanced by the judgemants implied in the astimates for 1961 to 1966.

1·3 The principel factors undarlying tha changes in total numbers of QSEs (total stock) ere:

New supply (Section 2)
The number of persons obtaining a first qualification in Graat Britain (including thosa awarded science degrees an route to a medical degree).

Immigration (Section 3)
The inward flows of QSEs identified in the estimates ara thosa born in Great Britain or the Commonwealth (including those who have returnad from studying in universitias abroad), thosa born in Northern Iraland and Republic of Ireland and thosa born in foreign countries.

Deaths (Section 4)
Deaths are estimated from occupationel mortality and age and sex spacific netional daath rates.

Emigration (Section 3)
The estimatas of emigration includa oversees graduates who obtain their degrees in Great Britain and then raturn to their own country.

1·4 Befora considering the flows it is appropriata to outline the concaptual basis of tha flow models for QSEs. It is pra-emptive in the sense that e person enters the stock on gaining his first qualification in engineering, technology or scienca at tha lavel prascribed in the definitions and steys in until he either dias or emigretes. In other words, any previously obtained quelificetions outside tha subjact range of the modal do not prevent e person's inclusion and any subsequently obteined qualificetions do not constitute a movamant out.

Coverage

1·5 This system of manpowar statistics has threa main feetures:

(a) the coverage is limited to the fourteen subject groups usad in tha 1961 census;

(b) tha stock includes all persons, including those economically inactive, who hold a first degraa or degree-level qualification in anginaering, technology or acienca;

(c) members of the stock ara permenently alloceted to tha model corresponding to the subject of the first relevant qualificetion that they obtain.

Classification by aubject

1·6 This coverage and set of definitions for tha modals were adopted by Mintech for e number of raasons:

(i) coding by tha subjact of the first degrea-level qualificatlon in engineering, technology or science gives the interface with the educational system which is the most practicabla for the model work;

(ii) while 'pre-empting' all science end anginearing graduates it doas not precluda a study of furthar qualificetions. This is done by cross-analysas of individuals within each modal;

(iii) this is a precisa and unambiguous classification. Engineering graduates in particuler may join mora than ona professional institution with en accaptabla award. Thus, if tha subject of the first degree is not uaed, the aubjact chosen for coding

PQ—C

at tha census becomes somewhat erbitrery. It could be the most recent membership of a professional institution, or the first or last stated on the schedule, or some othar criterion;

(iv) if it is possible only to ask for one qualification, as for example in e questionnaire addressed to amployers, the coding of a subject other than that of the *first* qualification mey lead to a shift from one discipline model to enother. Such a shift means thet the flows in the discipline models cennot be essessed and it introduces e large and unacceptable edditional error;

(v) pre-emption on the subject of the first dagree in engineering or science is essential for these models, otherwise the size of the stock alters uncontrollably. The model for chemistry (for exemple) could be depleted by a group of chemistry graduates taking a higher degree in business studies; alternatively, the model for electronic engineering could ba swollan by an unrecorded influx of physics graduates who have obtained higher qualificetions in electronics. The study of such peopla is better handled as a sub-group of physics.

1·7 Substitutability is of interest both to educetion planning and employers end is therefora relavant to manpower statistics. Three possible ways in which it can be seid to be reflected in the QSE modela are:

(i) spread of persons holding a qualification appropriate to e particuler occupation to occupations outside this ranga i.a. which appear to demand differant quelifications e.g. degree in physics in occupation 'elactronic engineer';

(ii) apread of persona holding degrees into what might be called 'cereer progression' occupations such as manager, administrator;

(iii) QSEs mey also be said to become substitutable with the ecquisition of a further qualification eppropriate to an occupetion other then that associated with their first degree.

Subject of qualification and occupation

1·8 Arising from the discussion of substitutability it is also useful to consider the question of subject of qualificetion versus 'occupation'. Experience has shown thet in the context of the discussion of substitutability in manpower anelysis e clear distinction must be drawn between the subject of qualification held by the individual and the type of post filled. It follows that the word 'scientist' or 'angineer' must be strictly reserved for those QSEs holding scientific or engineering *posts*, that is they era scientists or angineers *by occupation*.

1·9 This important distinction between subject of qualification and occupation cen be illustrated by the distribution of QSEs in the electronics industry in 1961 end 1966. The anelyses show that in 1966 only 66 per cent of QSEs in this industry are correctly described as 'engineers, technologists or sciantists'.

Subject of qualification end occupation

Distribution of QSEs in electronics

Per cent

Table 16	*1961*	*1966*
All posts	*100·0*	*100·0*
Managers	*11·2*	*14·0*
Engineers, technologists end scientists	*75·8*	*66·0*
Technician engineers, draughtsmen etc.	*10·3*	*15·2*
Other professionel, administretive end clerical	*2·7*	*4·8*

Source: Office of Population Censuses end Surveys

1·10 It can elso ba argued from the census data shown in the table that 19 per cent of QSEs heve 'substituted' another job skill for tha ona which matches their scientific or angineering quelificetion. (A further analysis by the higher quelificetions held by those QSEs will show whether the 'substitution' has been accompanied by e further qualification in a subject outside science and engineering.) The group 'engineers, technologists and scientists' in Tabla 16 itself probably conceals a proportion of substitutability e.g. a person with first degree quelification in chemistry may be in the occupetion chemicel engineering, having progressed by experience on the job.

Mejor flows

1·11 Tha three major flows associated with changes in tha stock era now discussed in turn. The final series are shown in Teble 28.

2 New supply

2·1 New supply is defined es the number of persons entering the stock by virtue of obtaining a first qualification at degree or degree level in engineering, technology or science. The number of persons obteining such quelificatione between 1958 end 1968 is shown in Table 17.

Intercensal yeare

2·2 In the five intercensal years, 1961 to 1965, new supply emounted to 94 760. Of these 63 870 were university graduates and 30 890 were non-graduates, of which 2560 were ecceptable essociateships from educational institutions. The remainder were persons who obtained other acceptable qualifications i.e. from a professional engineering, sciantific or technological institution (see Section 19 for details of inatitutions).

Pereons born within Great Britain who obtain qualifications outsida Graet Britain

2·3 A second, but much smaller, numbar of dagraes is awarded to British etudenta who graduete in e univeraity in Northern Iralend, the Republic of

Ireland or in soma other country and who then return to Great Britain. The 1966 census shows 200 British born graduate students in science who had reported an address abroad a year ago. It is reasonable to suppose that these had been undergraduates in some overseas university. Over the five-year period thia would amount to at least 1000 British students who graduated overseas. An allowance for these has been mada in estimating the studant component of immigration (Tables 19 and 21).

3 Migration

3·1 The impact on the total stock of new supply and deaths in Great Britain from one yaar to tha next is modified by tha migration flows; clearly, if emigretion and immigration are in balance the effect on the total numbers is nil. Since the two flows are to a large extent independent they are seldom compensatory and en attempt must be made to judge the international movement that is actually taking place.

3·2 It was noted in the report on *The Brain Drain, Report on the Working Group on Migretion,*[8] that data on migration of QSEs are incomplete. This statement is still true but the use of flow analysis and two census points now sets limits to the overall estimates. At first sight it might appear easier to consider only nat migration since this ia givan for the intercensal period by the residual difference between the overall change in stock on the one hand and the sum of new supply lass wastage from deaths on the other. However the two flows are subject to diffarent motivating forces and they must therafore be handlad aeparately.

Data aveilable

3·3 The information available on migration flows of QSEs has changed considerably over the ten-year period 1959 to 196B. At tha stage at which estimates wera mada for the report on *The Brain Drain,* the following components were used:

(I) *Sea manifests collected by the Boerd of Trade for United Kingdom and Commonwealth citizens.* This was a 50 par cant sample covering sea travel only; migration by air hed to ba estimated. It was assumed that the sama proportion travelled by air on the inward and outward journeys. This proportion was assessed for each geographical area by comparing tha number reported in tha see manifests with the outward flows assessed from othar data. The data from the sea menifests are not availabla after Dacember 1963 (sae also Section 21).

(ii) *Professional institutions.* These data have become more comprehensive ovar the pariod. They cover the science, engineering and technological profassions.

(iii) *Immigration authorities in USA, Canada and Australia.* An important source of supporting data from the destination countries.

(iv) *University Grants Committee.* Data are available from univarsity appointments officera who give detaila of overseas students returning to their own country after graduation and other new graduates going overseas.

3 4 More recently, information has become available from the International Passenger Survey (IPS). Since January 1964 data from a sample survey, carriad out by tha Office of Population Cansuses and Surveys go soma way to replace the saa manifest data. Designed for estimating national migration, the IPS gives ralatively lass firm estimates for specialist groups auch as QSEs.

3·5 In the earlier years it was always known that, even using all the eveilable data, some migrsting QSEs were not being taken into account. For example, tha data on the migration of scientists are

New supply of QSEa from aducational asteblishmenta in Great Britain and from profeseionai inatitutions

Table 17	Total QSEs	Engineering end technology			Science			Pre-clinical degreas [2]
		Total	Graduate[1]	Non-graduate	Total	Graduate[1]	Non-graduate	
1858	14 510	8 035	3 040	4 995	6 475	5 040	435	285
1850	16 390	8 910	3 500	5 310	7 480	7 005	475	190
1951	18 785	9 070	4 050	5 020	7 595	7 200	495	220
1962	17 035	8 820	4 190	4 630	5 215	7 395	820	250
1963	18 355	9 835	4 290	5 345	8 720	7 830	890	270
1964	20 320	10 410	4 590	5 820	9 910	8 925	985	245
1955	22 285	11 475	5 515	5 980[3]	10 810	9 885	925	260
1956	23 430	11 825	6 350	5 475	11 805	10 405	1 200	325
1967	24 780	12 290	8 975	5 315	12 500	11 410	1 090	410
1968	27 455	13 015	7 990	5 025	14 440	13 280	1 160	438

(1) Including Dip Tech end CNAA degrees.
(2) Pre-clinical degraes in enatomy end physiology taken en route to a medicel degree end includad with science graduates.
(3) Includaa 530 members of the Natlonel Associetion of Colliery Manegers who joined the Institute of Mining Engineers in 1965 end therefore ceme within the population.

Sources: University Grants Committee
Council of Engineering Institutions
Council of Science end Technology Institutes

recorded in terms of tha occupation of the migrants and in soma occupations tha QSEs are not identified. The main omissions are teachers (other than university), managers, other non-scientific occupations and the aconomically inactive.

3·6 The lack of comprehansive data on tha immigration of QSEs prompted special tabulations from the 1966 census. The then Genaral Register Office arranged a tabuletion of QSEs, 'reporting an address outside Great Britain one year ago', to match the othar Mintech data in both coverage and subject classification. The analysis shows thet 8100 QSEs had an address outside Greet Britain one year ago. Of these 410 gave their usual address as being overseas, that is they were visitors to the country. These were excluded from the estimates of immigrants (see Table 18). The new question on the 1968 census schedule gave tha best estimate so far available of the total inflow for one year prior to the census, 1965.

3·7 To match the IPS series thia estimate from the census should be converted to a calendar year basis. (The method of conversion is described in tha Appendix.) Estimates for the earlier years were obtained by taking the base year 1965 as 100 and working back using the mein series, integrating sea manifast, IPS and professional institution data. Thesa give total immigration for the fiva yea s 1961 to 1965, sub-divided by subject qualification (see also Section 21).

The migration estimetes used in the current study 1961 to 1965

3·8 The availability of the two census points provides, as had been planned, a means of checking the estimatas for the intercensal period. The total stock change was estimated between April 1961 and April 1966, so also was new supply and estimated deaths. With en estimate of immigration established using tha base figure in 1965 and data from the IPS and the sea manifests, the total emigration in the five years can ba obtained as e counter flow. From the point of view of the current stock/flow exercise there is, therefore, an absolute constraint on the overall estimates of net migration from 1961 to 1965. It was then checked that the previous estimetes lay within these comprehensive estimates.

1959 to 1960

3·9 For these years the astimates given in the *Report of the Working Group on Migration* have been adjusted by allowing for occupations not previously covered end the non-Commonwealth migrants (see Saction 21).

1966 to 1968

3·10 Estimates for thesa years are based on:

(a) Engineering, tha data from the institutions and overseas immigration authoritias.

(b) Scienca
  (i) tha data available from the UGC, from professional institutions end from oversaes immigration authoritias and,
  (ii) estimates for other emigrants (not in scientific occupations) using the data availabla from the International Passenger Survay.

As will be seen, the estimatas for scienca depend much more heavily on procadurea uaing the IPS as previously described. This is a factor taken into account in assessing the science stock 'balanca' for January 1968. Tha final figures are shown in Tablas 21 and 22.

3·11 Finally, it is interesting to compare current estimates with those given in *The Brain Drain*. Tha current estimates of emigration are unchangad for those in engineering posts, as ara the astimates for science QSEs travelling as 'sciantists' in 1965. The immigration figures, which wera no more than orders of magnitude, compare as follows:

	The Brein Drein	Current estimetes	Difference
1965	1 085	1 130	+ 4%
1966	1 150	1 010	—12%

The numbers of QSEs who travel as teachers, etc. are shown in Tables 21 and 22.

3·12 The current estimatas also includa

(a) overseas born QSEs leaving after obteining a qualification and arriving to study for a highar qualification or to take a course,

(b) the flows of QSEs who are Irish and foreign born.

The correct intercensal changes in amployment are incorporated in the tebles. The procedure for obtaining these estimates is described in Section 21.

Immigration of QSEs
April 1965 to April 1966

Teble 18	All Immigrants	Engineering end technology			Science		
		Census	Fector[1]	Corrected census	Ceneue	Fector	Corrected census
Totel	8 100	3 130	0·976	3 055	4 970	0 976	4 850
Economically active	6 380	2 640	0·975	2 575	3 740	0·975	3 645
Inactive	550	190	0·951	180	360	0·951	340
Students	t 170	300	0·994	300	870	0·994	865

(1) The fector serves both to remove the visitors end to correct for understetement in the 1966 Census.

Source: Office of Populetion Censuses end Surveys

Immigration

Persons with qualifications in engineering and technology

Table 19	All immigrants	Economically active			Students[3]	Other inactive
		Total	Engineers	Other[2]		
1958	1 785	1 480	1 080	400	195	110
1959	2 025	1 695	1 240	455	200	130
1960	2 110	1 780	1 285	475	220	130
1961	3 215	2 760	2 035	725	245	210
1962	3 025	2 575	1 890	885	255	195
1963	2 240	1 840	1 340	500	260	140
1964	2 355	1 940	1 425	515	275	140
1965[1]	*3 125*	*2 645*	*1 935*	*710*	*300*	*180*
1966	2 780	2 180	1 595	585	415	185
1967	2 440	2 000	1 465	535	290	150
1968	2 865	2 385	1 740	645	300	180

(1) Estimates based on the census are printed in italics.

(2) Managers, teachers, medical workers and other occupations.

(3) Numbers of overseas students in Great Britain used as an index (see Table 3 *Statistics of Education* 1966 Vol. 6).

Sources: Office of Population Censuses and Surveys
Council of Engineering Institutions

Emigration

Persons with qualifications in engineering and technology

Table 20	All emigrants	Economically active[1]	Students[2]	Other inactive[3]
1958	2 725	2 250	345	130
1959	2 525	1 935	455	135
1960	2 530	1 935	455	140
1961	2 430	1 875	410	145
1962	2 735	2 180	400	155
1963	3 085	2 435	465	155
1964	3 750	3 050	530	170
1965	4 050	3 235	635	180
1966	5 255	4 310	755	190
1967	8 180	5 190	795	195
1968	4 945	3 870	870	205

(1) The data provided by the professional engineering institutions do not distinguish the engineers from those in other occupations. The number of university teachers is too small to show separately. New graduates going to posts overseas are included.

(2) Great Britain graduates going overseas for research or further study and overseas students who have graduated returning home to their own country.

(3) 0·10 per cent of total stock assumed to be emigrating as 'other inactive'.

Sources: Office of Population Censuses and Surveys
University Grants Committee
Council of Engineering Institutions

Immigration

Persons with qualifications in science

Table 21

	All immigrants	Economically active				Students[3]	Other inactive
		Total	Scientists	Teachers[2]	Other occupations		
1958	3 405	2 595	1 120	585	910	555	255
1959	3 935	3 080	1 525	635	920	580	275
1960	4 100	3 180	1 500	750	830	535	285
1961	4 035	3 005	1 325	785	915	710	320
1962	4 265	3 255	1 550	735	970	730	300
1963	4 220	3 170	1 550	635	985	750	300
1964	3 910	2 820	1 225	595	1 000	790	300
1965[1]	*4 880*	*3 675*	*1 890*	*740*	*1 045*	*865*	*340*
1966	4 720	3 520	1 670	845	1 005	880	340
1967	4 160	2 975	1 260	665	1 050	660	325
1968	4 870	3 745	1 645	840	1 060	865	360

(1) Estimates based on the census are printed in italics

(2) Excluding university teachers. Up to 1963 estimates are based on the sea manifests. From 1964 onwards estimates are based on census information and the International Passenger Survey.

(3) Number of overseas students in Great Britain used as an index (See Table 3 *Statistics of Education* 1968 Vol. 6).

Sources: Office of Population Censuses and Surveys
Council of Science and Technology Institutes

Emigration

Persons with qualifications in science

Table 22

	All emigrants	Economically active				Students[3]	Other[4] inactive
		Total	Scientists[1]	Teachers[2]	Other occupations		
1956	2 885	2 135	1 260	670	205	530	220
1656	2 855	1 670	1 150	630	190	655	230
1960	2 695	1 765	1 065	530	160	665	245
1961	3 135	2 150	1 275	650	225	725	280
1962	3 100	2 210	1 325	660	225	615	275
1963	3 490	2 420	1 560	595	285	780	290
1664	3 880	2 745	1 605	640	300	830	305
1965	4 240	3 030	1 990	720	320	885	325
1966	4 470	3 195	2 180	870	345	635	340
1967	4 895	3 585	2 295	615	375	950	350
1968	4 995	3 460	2 215	675	370	1 155	380

(1) Data obtained from sea manifests, immigration authorities of recipient countries, University Grants Committee, science institutes and International Passenger Survey. New graduates going to posts overseas are included.

(2) For teachers, the IPS ratio of immigrants/emigrants has been used to convert the figure (based on the census) of science teachers who immigrated in 1965 into an estimate of emigrants. The time-series post-1964 has been prepared by using IPS data as an index of change. The link between 1963 and 1964 was made using the 'scientist' series.

(3) Graduates from Great Britain going overseas for research or further study and overseas students returning to their own country.

(4) 0·19 per cent of total stock assumed to be emigrating as 'other inactive'.

Sources: Office of Population Censuses and Surveys
University Grants Committee
Council of Science and Technology Institutes

Balance of migration of QSEs

1958 to 1968

Table 23	Emigration		Immigration		Balance of migration	
	All emigrants	British and Commonwealth only	All immigrants	British and Commonwealth only	All migrants	British and Commonwealth only
All migrants						
1958	5 610	5 055	6 190	3 965	— 420	—1 090
1959	6 380	4 875	6 960	4 455	+ 580	— 420
1960	5 225	4 725	8 210	4 675	+ 985	— 50
1961	5 565	4 990	7 250	5 496	+1 685	+ 505
1962	5 835	6 240	7 310	5 505	+1 475	+ 265
1963	5 555	5 870	8 460	4 930	— 95	— 940
1964	7 630	8 845	6 265	4 735	—1 366	—2 110
1965	8 290	7 440	8 005	8 135	— 285	—1 305
1966	9 726	8 830	7 480	5 820	—2 245	—3 010
1967	11 075	10 150	6 600	5 230	—4 475	—4 920
1968	9 940	8 985	7 835	6 050	—2 105	—2 935
Engineering and technology						
1958	2 725	2 665	1 785	1 340	— 940	—1 225
1959	2 525	2 390	2 025	1 520	— 500	— 870
1960	2 530	2 395	2 110	1 585	— 420	— 810
1961	2 430	2 300	3 215	2 410	+ 785	+ 110
1962	2 735	2 580	3 025	2 265	+ 290	— 315
1963	3 065	2 890	2 240	1 690	— 825	—1 200
1964	3 750	3 540	2 355	1 785	—1 395	—1 755
1965	4 060	3 820	3 125	2 355	— 925	—1 485
1865	6 265	6 025	2 760	2 080	—2 495	—2 945
1967	6 180	5 880	2 440	1 835	—3 740	—4 145
1968	4 945	4 715	2 865	2 155	—2 080	—2 560
Science						
1958	2 885	2 490	3 405	2 625	+ 520	+ 135
1959	2 855	2 485	3 935	2 935	+1 080	+ 450
1860	2 695	2 330	4 100	3 090	+1 405	+ 750
1961	3 135	2 690	4 035	3 085	+ 900	+ 395
1962	3 100	2 660	4 285	3 240	+1 185	+ 580
1963	3 490	2 980	4 220	3 240	+ 730	+ 260
1964	3 880	3 305	3 910	2 950	+ 30	— 355
1985	4 240	3 820	4 880	3 780	+ 640	+ 160
1966	4 470	3 805	4 720	3 740	+ 250	— 85
1967	4 895	4 170	4 160	3 395	— 735	— 775
1968	4 995	4 270	4 970	3 895	— 25	— 375

Source: Ministry of Technology

4 Deaths

4·1 Death rates for QSEs are estimeted using three sets of data prepared by the Office of Population Censuses and Surveys:

(i) the number of deaths end the *de facto* mid-year population of Greet 8ritain, analysed by age and sex for each year from 1959 to 1968;

(ii) ege distributions of QSEs et the 1961 and 1966 Censuses of Population: (meles and femeles enelysed seperately) for engineering end technology, and for science;

(iii) stendardized mortality retios for engineers end scientists: age weighted, based on the 1961 Census of Population.

4.2 Using the above data, sets of death rates are calculated in six age groups, separately for engineering and science. Age distributione are known only for the census years; weighting co-efficients for the intervening yeers are derived by linear interpolation through the known values end extrapoleted to 1959 and 1968. The six age groups ere:

20—24
25—34
35—44
45—54
55—64
65 and over.

4.3 Table 24 illustrates the first stage, the celculetion of the sex-weighted death retes for each age group. The proportion of males to females is very much higher in engineering then science and this is taken into account in these sex-weighted death rates. The example in Table 24 shows part of the celculations for science i.e. age group 35 to 44 for the yeers 1959 to 1968.

QSEs eged 35 to 44 with quelifications in science

Celculetion of sex-weighted death rates per cent

Teble 24	Retio of males to femeles	Death retes for GB popuietion		Calculated sex weighted death rete
		Meles	Females	
1959	3·52 : 1	*0·25*	*0·18*	*0·23*
1960	3·63 : 1	*0·25*	*0·18*	*0·23*
1961	3·74 : 1	*0·25*	*0·18*	*0·24*
1962	3·85 : 1	*0·25*	*0·18*	*0·24*
1963	3·96 : 1	*0·25*	*0·18*	*0·24*
1964	4·07 : 1	*0·25*	*0·18*	*0·24*
1965	4·18 : 1	*0·25*	*0·18*	*0·24*
1966	4·29 : 1	*0·25*	*0·18*	*0·24*
1967	4·40 : 1	*0·24*	*0·17*	*0·23*
1968	4·51 : 1	*0·24*	*0·17*	*0·23*

Sources: Office of Population Censuses and Surveys; Ministry of Technology

4.4 The second stege takes eccount of the relative occupational risk, compared with the total population. Such a measure is provided by the standerdized mortality ratios (SMR) calculeted by the Office of Population Censuses and Surveys for e wide renge of occupations. The ratio is 50 per cent for engineers and 48 per cent for scientists. It is celculated for all persons between 20 and 64 yeers of age and is applied to the first five ege groups given in paregraph 4.2.

4.5 Finelly, overall deeth rates for engineering and science are celculated applying the derived ege-weighted, occupation-specific deeth rates for the six age groups. Age distributions ere derived from those given by the Census of Population 1961 and 1966 using linear interpoletion end extrapolation for the remaining years. Table 25 shows overall death rates for total stock and economically active stock which are used in the enalyses of flows in Table 28.

Deeth retes

Age-weighted occupation-specific

Per cent

Table 25	Total stock		Economically ective stock	
	Engineering	Science	Engineering	Science
1959	*0·86*	*0·70*	*0·46*	*0·41*
1960	*0·80*	*0·74*	*0·45*	*0·40*
1961	*0·84*	*0·77*	*0·46*	*0·40*
1962	*0·86*	*0·74*	*0·45*	*0·39*
1963	*0·89*	*0·77*	*0·46*	*0·39*
1964	*0·83*	*0·70*	*0·43*	*0·36*
1965	*0·86*	*0·71*	*0·43*	*0·36*
1966	*0·88*	*0·72*	*0·43*	*0·35*
1967	*0·83*	*0·68*	*0·41*	*0·33*
1968	*0·89*	*0·70*	*0·42*	*0·34*

Source: Ministry of Technology

5 Changes in total stock

5.1 The orders of magnitude of the four flowa, new supply, immigration, deaths end emigration have now been estimated. These flow series together indicate the chengee in totel stock for the years 1959 to 1968 and, in combination with the estimates given by the Censuses of Population, give e series for totel stock for this period (Table 28).

5.2 It is useful to look first at the net belance of flows. This is set out in Table 26. The 'naturel increase' shown is taken to be new supply less the losses to the stock from estimeted deaths.

Net chengee in numbers of QSEs
1961 to 1966

Teble 26	Engineering end technology	Science
Overall chenge	+39 440	+42 950
Natural increase*	+42 315	+39 635
Gein or loss from migretion:	—2 875	+3 315
Foreign born	+2 450	+2 030
Commonwealth or Irish born	+220	+830
Great Britain born	—5 555	+455

*New supply less deeths. *Sources:* Ministry of Technology
Office of Population
Censuses and Surveys

5.3 The difference between the two sets of estimates comes out very clearly. The analysis shows that, whereas the natural increase (new graduates minus deeths) of persons with science qualifications wes augmented by the international movement of science graduates, the naturel increasa of qualified persons in engineering and technology suffered a net loss of approaching 3000.

5.4 A more expandad summary for the intercensal period is shown in Table 27. The same deta ere illustrated in the charts in Part One. These show the everage geins and losses from the four flows in the intercensal period compared with tha two-year period before and after.

Estimated geins end lossae of QSEs
Intercensal years 1961 to 1966

Teble 27	Engineering end technology	Science
CHANGE IN STOCK 1951 TO 1955	+39 440	+42 950
GAINS		
All geins	+53 220	+56 715
New qualifications	+49 410	+45 350
Immigration:		
Total	+13 810	+21 365
British, Commonwealth and Irish born	+11 040	+17 135
Foreign born	+2 770	+4 230
LOSSES		
All losses	—23 760	—23 765
Deaths	—7 095	—5 715
Emigration:		
Total	—15 885	—18 050
British, Commonwealth and Irish born	—16 375	—15 850
Foreign born	—310	—2 200

●See also Table 57. *Sources:* Ministry of Technology

Estimates of total etock

5·5 The annuel enalysis of flows and the resulting estimates of total stock from 1959 to 1968 ere given in Teble 28.

Seasonal variations in stock estimetes

6.6 The possibility of seesonal variations being significant in the overall estimates must be considered since the census observations ara all taken at and April whereas the flow series fall naturally into calendar years. An attempt is made in Teble 29 to estimeta how much correction needs to be applied to e valua from the April census to arrive at a January equivalent.

5.7 Tha incidence of new supply in the third quarter of each year and heavier-than-averege deaths in tha Januery to April period laads to an oscillation in the level of total stock of up to 0·5 par cent within the latter period. There is, of course, no immutable seasonal pattern as the belance of migration can either intensify the seasonal variation or offset it.

5.8 This seasonal movement has only a small effect on the totel numbers of QSEs during the period Jenuary to April. However the amount of the seasonal variation has been estimeted, so that this factor can be separately accounted for when estimates using differant procedures are compared. (See Table 34 where the estimates ere given for economically active stock.) It is observed that the differences are wall within the sampling error.

6 Numbers out of employment

6.1 The finel stege of the assessment of stock is the study of the eeries of activity rates. On a simple assumption, ectivity rates for the years other then the censuses could be derived using linear intarpolation end extrapolation. However, it was decided to use the series of activity rates implied by the estimates of QSEs in employment derived from the combination of censuses and surveys as described in Part Three (Table 40). 8efore these activity rates can be calculeted it is necessery to estimate the number of QSEs *out of employment* during the nine-yeer period end so convert the numbers 'in employment' into the economically active stock in each year.

6.2 The data available for making estimates are:

(a) numbers shown to ba out of employment in the 1961 and 1966 Censuses of Populetion;

(b) number of respondents who reported that they were unemployed in the 1968 surveys of professionel engineers and scientists;

(c) the time series of percentege rates of unemployment by the Department of Employment and Productivity;

(d) numbare of new graduates who are seaking employment es reported by university appointments officers.

6.3 The anelyses of census data for 1961 and 1968 ehow that the numbers out of employment more then doubled over the five years. Table 30 shows that, while tha absolute numbers of engineering and science OSEs are very similar, the percentage rate is slightly higher for science.

Analysis of stock and flows

Figures in brackets are totals for the intercensal period

Table 28	Stock at beginning of period	Inflow		Outflow		Stock at end of period
		New supply	Immigration	Deaths	Emigration	
Engineering and technology						
1959	133 170	8 035	2 025	1 145	2 525	139 560
1950	139 560	8 910	2 110	1 115	2 530	148 935
1961 pre-census	148 935	—	875	410	530	146 670
		(49 410)	(13 810)	(7 095)	(18 885)	
post-census	145 870*	9 070	2 340	820	1 900	155 560
1962	155 580	8 820	3 025	1 340	2 735	163 330
1963	183 330	9 635	2 240	1 450	3 065	170 690
1964	170 690	10 410	2 355	1 415	3 750	178 290
1985	175 290	11 475	3 125	1 530	4 050	187 310
1866 pre-census	187 310	—	725	540	1 185	186 310
post-census	166 310*	11 525	2 035	1 110	4 070	195 000
1987	195 000	12 290	2 440	1 820	6 180	201 930
1958	201 930	13 015	2 865	1 795	4 945	211 070
Science						
1959	122 175	5 475	3 935	855	2 655	128 875
1960	128 675	7 480	4 100	955	2 695	136 605
1961 pre-census	136 805	—	610	355	335	135 725
		(45 350)	(21 355)	(5 715)	(18 050)	
post-census	135 725*	7 895	3 425	695	2 800	144 350
1982	144 350	8 215	4 285	1 070	3 100	152 680
1963	152 680	8 720	4 220	1 180	3 490	160 950
1984	160 950	9 910	3 910	1 130	3 880	159 750
1965	169 760	10 810	4 880	1 210	4 240	180 000
1985 pre-census	180 000	—	645	430	540	179 675
post-census	179 675*	11 605	4 075	860	3 930	190 565
1967	190 565	12 500	4 160	1 295	4 895	201 035
1968	201 035	14 440	4 970	1 405	4 995	214 045

*Census figures.

● See Tables 17 and 23.

Source: Ministry of Technology

6.4 The unemployment rates for QSEs are compared with the national percentage rate in Table 31. For science qualifications the QSE rate is a little over half the national rate in 1961 but is equal to it by 1966—both being 1·3 per cent. For those with engineering qualifications, the ratio is 44 per cent of the national rate in 1961 and 83 per cent in 1966.

6.5 To obtain an estimate of the rate of unemployment for QSEs, the ratio of QSE to the Great Britain percentage unemployment has been interpolated. A special rate was calculated from the numbers wholly unemployed less those temporarily stopped and school leavers (Employment and Productivity Gazette[3]).

Conversion of economically active stock at census to January

Table 29	Engineering and technology		Science	
	1951	1956	1961	1966
Economically active stock at census	138 480	170 415	111 545	145 300
Add back:				
Retirement and withdrawal	525	555	435	540
Emigration	495	1 135	285	480
Deaths	205	240	145	155
Remove:				
Immigration	610	675	555	590
Economically active stock at previous January	138 895	171 680	111 855	145 895
Total adjustment (January to April):				
Number	—415	—1 265	—310	—595
Per cent	*0·303*	*0·737*	*0·277*	*0·408*

● See also Tables 23, 27 and 34.

Source Ministry of Technology

QSEs out of employment at the census and as a percentage of economically active stock

Table 30	1961	1868	Change 1961 to 1986
Numbers out of employment			
Engineering and technology	845	1 845	+1 000
Science	880	1 900	+1 040
Percentage rate			
	%	%	%
Engineering and technology	*0·62*	*1·08*	*+0·46*
Science	*0·77*	*1·30*	*+0·53*

Source: Office of Population Censuses and Surveys

6·6 The assumption has been made that, other things being equal, the unemployment rate (including unemployed sick) for QSEs can be expected to progressively approach the national rate. In science this point is reached by 1966. In the absence of any evidence to the contrary, it is assumed that the ratio may be interpolated for the intercensal years and for 1959 to 1960 and 1967 to 1968.

6.7 As during 1962 and 1963 unemployment in Great Britain reached quite high levels, the procedures demonstrated in Table 31 give a high rate of unemployment for QSEs. This has been checked by studying data on new graduates 'seeking permanent employment' supplied by the university appointments officers and through the professional institutions. Both sources of information confirm that employment of QSEs was also affected adversely by the 1962/1963 recession.

6.8 The results of this estimating procedure are as follows:

Science

As already noted the unemployment rate for science equalled the national rate in 1968, 1·3 per cent, in 1968 the 'expected' rate becomes 2·4 per cent, implying 3906 out of employment.

Engineering and technology

By assuming that the engineering rate will also continue to approach the national rate, the expected 1968 rate becomes 2·37 per cent, giving an 'expected' unemployment of 4390.

CEI survey data

6.9 An independent estimate of unemployment of QSEs with engineering qualifications is obtained for 1968 from the joint CEI/Ministry of Technology study in 1968.[10] This shows unemployment among the respondents to be 0·4 per cent. The equivalent percentage for the science respondents in the joint CSTI/Ministry of Technology study[11] is 1·0 per cent. From these results two things can be deduced:

(i) the rates for both groups are well below the 'expected' rate,

(ii) the engineering rate is considerably below the science rate.

Assessment of 'expected' unemployment amongst QSEs 1959 to 1968[1]

Table 31	Great Britain percentage rate[2]	Engineering and technology			Science		
		QSEs[3] out of employment	QSE percentage rate	Ratio QSE: GB rate	QSEs[3] out of employment	QSE percentage rate	Ratio QSE: GB rate
1959	2·2	1 215 (38)	*0·97*	0·443	1 215 (88)	*1·21*	0·550
1850	*1·7*	980 (28)	*0·75*	0·443	895 (85)	*0·94*	0·550
1961 census	*1·4*	845 (20)	0·62	0·443	660 (105)	0·77	0·660
1962	*1·8*	1 355 (30)	*0·94*	0·521	1 350 (123)	*1·15*	0·640
1963	2·5	2 260 (90)	*1·50*	0·598	2 276 (197)	*1·83*	0·730
1964	*1·7*	1 805 (56)	*1·15*	0·676	1 820 (228)	*1·39*	0·820
1965	*1·4*	1 715 (52)	*1·05*	0·753	1 750 (160)	*1·27*	0·910
1966 census	*1·3*	1 845 (44)	1·06	0·831	1 900 (146)	1·30	1·000
1967	2·3	3 736	*2·09*	0·909	3 550	2·30	1·000
1968	2·4	4 390	*2·37*	0·886	3 905	*2·40*	1·000
1967[4]		1 100 (80)	*0·62*		3 040 (202)	*1·97*	
1968[4]		940 (115)	*0·51*		3 200 (339)	*1·97*	

(1) The assumption is that, other things being equal, the unemployment rate for QSEs can be expected to progressively approach the national rate. In science this point is reached by 1966. The higher unemployment rate estimated for 1963 is confirmed by data from the university appointments officers and from the professional institutions.

(2) Wholly unemployed less temporarily stopped and school leavers.

(3) New graduates seeking permanent employment are shown in brackets.

(4) Unemployment figures adjusted to allow for emigration which is over and above the normal international circulation (see Table 33).

Sources: Office of Population Censuses and Surveys
Department of Employment and Productivity
University Grants Committee
Ministry of Technology

6.10 Of course it is possible that, as tha respondants to both surveys are membars of professional institutions, a lower figure than the rate for all QSEs might be expected. Furthermore, it is known that rasponse rates are lower for people who are suffering from a misfortune such as loss of job or illness; and the survey rate may therefore understate the trua position. The second feature of the survey rasults suggests that the employment situation is different for engineering and science and this is causing some difference on the level of unemployment.

Effact of international movemant

6.11 It is reasonable to suppose that the acceptance of posts abroad would have soma effect on the level of unemployment in Great Britain, though it is difficult to measure how much. The discussion of migration in Saction 3 shows that net migration of QSEs in engineering is much greatar than that for scienca. In science, where the balance of migration did not become nagative until 1967, no such effect would be expected. Is it possible, therefore, that emigration may have vitiated the assumption made in drawing up Table 31, that is, that the engineering rate (like the science rate) would draw gradually closer to the national rate?

6.12 To test this hypothesis, an attempt has been made to measura the effect that emigration might have had on the level of unemploymant in January 1968. The test depends on a number of assumptions:

(a) that there is a 'normel international circulation' of QSEs on business, academic and family affairs which continues irrespective of economic climate;

(b) that this level of intarnational circulation can ba identified and measured by taking the lowest observations of the fluctuating curve of immigration (1·4 per cent of total stock for engineering and 2·2 per cent for scianca) (see Tables 19 and 21);

(c) that emigration, over and above the balancing international circulation level, can be considered residual or excess emigration. (This is possibly a better measure of the Brain Drain than the total figures used in earlier discussions);

(d) that there is no build up of unemployment between ona January and the next. (The CEI survey showed that less than 6 per cent remain unemployed for longer than a year.)

6.13 While it is not possible to prove that all the engineers who cannot be accounted for emigratad to avoid unemployment, the high national rate, tha low level of investment in 1966 and 1967 and the rationalization experienced in the engineering industries makes this a reasonable assumption. The arithmetic of the test is shown in full in Tabla 33 for angineering and science separately. It is interasting that the 'residual unamployment' for engineering becomes 0·5 per cent of economically activa stock which is closer to the CEI estimate of 0·4 par cent. When some allowance is made for 115 new graduates who were seeking permanent employment in January 1966 (many of whom are outside the professional institutions) the estimate of 0·51 is much nearer to the CEI result.

6.14 The science rate on this basis falls from 2·40 to 1·97. The calculated rate is almost twice the CSTI rate, compared with a 25 per cent difference for engineering. This difference can ba explained by tha women QSEs who are on the DEP register but who are not mambers of a scianca institute. Women QSEs in science out of employment wera 2·6 per cent at the census compared with 1·09 per cent for men.

6.15 It will have been obsarved from Table 20 that the upswing in emigretion of QSEs in engineering was first apparent in 1965. It follows that the numbers out of employment recorded at the census might hava been affected. A similar correction for 'excass' emigration would raise the numbers out of employment in 1966, such that the rate was 1·3 per cant (instead of 1·08 per cent), the same as that reportad for sciance QSEs.

QSEs out of employment

Estimated number and per cent of economically active stock

Table 32	Engineering and technology		Science	
	Number	*Per cent*	Number	*Per cent*
1959	1 215	*0·97*	1 215	*1·21*
1961 census	845	*0·62*	860	*0·77*
1962	1 355	*0·94*	1 350	*1·15*
1966	1 715	*1·05*	1 750	*1·27*
1966 census	1 845	*1·08*	1 900	*1·30*
1966	940	*0·51*	3 200	*1·97*

Sources: Office of Population Censuses and Surveys
Ministry of Technology

6.16 It has been concluded from this evidenca:

(a) that tha international movement of QSEs is a direct influenca on the numbers recorded as out of employment (as for exampla in the CEI end CSTI Surveys);

(b) that the method shown in Table 33 gives the best estimate of numbers out of employment in 1967 and 1968.

7 Activity rates for QSEs

7.1 A complete series of estimates of the economically activa stock and activity rates in January of each year may now ba calculated. The necessary steps ara:

(a) convert the census figures for April to astimates for January;

(b) calculate the activity rata implied by these January estimates of economically activa stock;

(c) estimate activity rates for tha survay yaars;

(d) estimate activity rates for tha other years.

January astimatas of economically active stock

7.2 The Jenuary estimate of the aconomically active stock is obtained by adding back to the census figure for April the numbers who have left the economically active stock since January that is deaths, emigrants and retirements. Immigrants, on the other hand, must be deducted. The arithmetic is shown in Table 29. The number of QSEs who retired is estimated from earlier damographic studies basad on tha 1961 census data. It is found that the January estimates are always higher; thay differ from the April estimates by betwaen 310 and 1265 QSEs depending on tha estimated balance of migration.

Activity rataa 1961 and 1966

7.3 The total aconomically activa stock so derived is then compared with tha total stock at January and tha activity rata calculated (see Tabla 35).

Two things hava baen observed about tha levels of activity in January:

(i) The activity rate for science is considerably lower than for engineering; this can be attributed almost entirely to the numbar of women scianca QSEs;

(ii) The faster decline in the level of ectivity for engineering QSEs betwaen 1961 end 1966, 1·5 per cent compared to 0·7 per cent for scianca.

Approximata measure of tha effact of additional amigration on unamployment

Table 33

	1966		1967		1968
	Jenuery stock	Flow	January stock	Flow	January stock
ENGINEERING AND TECHNOLOGY					
Total stock	187 310		195 000		201 930
Economically ective stock (Table 36)	171 680		178 775		185 150
Totel emigretion (Table 20)		5 255		8 180	
Level of emigration assumed to be the normal internationel circulation, 1·4 per cent of total stock[1]		2 620		2 730	
Residual emigration		2 535		3 450	
Unemployment					
'Expected' unemployment (Table 31)			3 735		4 390
Deduct residuel emigration of previous calendar year from 'expected' unemployment			2 635		3 450
Adjusted unemployment	1 845		1 100		940
Implied unemployment rate es per cent of economically ective stock	*1·08*		*0·62*		*0·51*
SCIENCE					
Total stock	180 000		190 565		201 035
Economically ective stock (Table 36)	145 895		154 300		162 640
Totel emigretion (Teble 22)		4 470		4 895	
Level of emigretion assumed to be the normel internationel circuletion, 2·2 per cent of totel stock[1]		3 960		4 190	
Residual emigration		510		705	
Unemployment					
'Expected' unemployment (Table 31)			3 550		3 905
Deduct residuel emigration of previous calendar yeer from 'expected' employment			510		705
Adjusted unemployment	1 900		3 040		3 200
Implied unemployment rate es per cent of economically ective stock	*1·30*		*1·97*		*1·97*

(1) This le assumed to be the lowest rate observed in the fluctuating curve of immigration

Sources: Department of Employment and Productivity
Ministry of Technology

Aesessment of activity rates for QSEs

Table 34

	Total stock	Census and survey years: In employment	Seasonal adjustment	Out of employment: Per cent	Out of employment: Number	Economically active	Activity rate	Non-survey years: Activity rate	Economically active	Out of employment
							%	%		
Engineering and technology										
1959	133 170	123 195	+710	*0·97*	1 215	125 120	*93·96*			
1960	139 560		+695	*0·75*				*93·57*	130 585	980
1961	146 935	135 635	+415	*0·62*	845	135 895	*93·17*			
1962	155 560	142 155	+580	*0·94*	1 355	144 100	*92·63*			
1883	183 330		+875	*1·50*				*92·32*	150 785	2 260
1964	170 690		+1 010	*1·15*				*92·01*	157 050	1 805
1965	178 290	160 915	+880	*1·05*	1 715	163 490	*91·70*			
1968	187 310	168 570	+1 255	*1·08*	1 845	171 680	*91·66*			
1967	195 000		+1 540	*0·62*				*91·68*	178 775	1 100
1968	201 930	183 080	+1 130	*0·51*	940	185 150	*91·69*			
Science										
1959	122 175	98 945	+255	*1·21*	1 215	100 425	*82·20*			
1980	128 875		+275	*0·94*				*81·98*	105 550	995
1961	136 805	110 585	+310	*0·77*	860	111 855	*81·76*			
1982	144 350	115 875	+360	*1·15*	1 350	117 585	*81·46*			
1963	152 680		+440	*1·83*				*81·36*	124 220	2 275
1964	160 950		+570	*1·39*				*81·27*	130 805	1 820
1965	169 760	135 555	+485	*1·27*	1 750	137 790	*81·17*			
1968	180 000	143 400	+595	*1·30*	1 900	145 895	*81·05*			
1967	190 565		+740	*1·97*				*80·97*	154 300	3 040
1958	201 035	158 805	+635	*1·97*	3 200	182 640	*80·90*			

● See also Tables 29, 31, 36 and 40.

Source: Ministry of Technology

Activity rates for the survey years

7.4 The estimates of the numbers of QSEs who are economically active in the survey years are given by taking the estimates of QSEs in employment (Part Three, Table 40) and adding in estimates for those out of employment. For the years outside censuses and surveys a simple linear interpolation has been assumed between the values already calculated for activity rates in survey and census years. The procedure is illustrated in Table 34.

7.5 The complete series of activity rates for January are presented in Table 35. It will be noted that the census (April) observations given for comparison differ slightly from those for January.

Estimated activity rates 1959 to 1968

Per cent

Table 35

	Engineering and technology: January estimates	Engineering and technology: Census observations	Science: January estimates	Science: Census observations
1959	*93·96*		*82·20*	
1960	*93·57*		*81·98*	
1961	*93·17*	*92·93*	*81·76*	*81·58*
1962	*92·63*		*81·46*	
1963	*92·32*		*81·36*	
1964	*92·01*		*81·27*	
1965	*91·70*		*81·17*	
1966	*91·68*	*91·47*	*81·05*	*80·87*
1967	*91·68*		*80·97*	
1968	*91·69*		*80·90*	

Sources: Office of Population Censuses and Surveys
Ministry of Technology

Economically active and inactive stock

7.6 The activity rates shown in Table 35 are now used to provide a set of estimates of QSEs who are 'economically inactive', that is they are students, retired or not seeking employment (for example married women at home). The full set of estimates is shown in Table 36 for the years 1959 to 1968. In 1968, it is estimated that 347 790 QSEs were economically active, 122 245 or 54 per cent above the estimated number in 1959.

Summary of total, economically active and inactive stock 1959 to 1968

In January of each year

Table 36	Total stock			Economically active			Inactive		
	All subjects	Engineering and technology	Science	All subjects	Engineering and technology	Science	All subjects	Engineering and technology	Science
1959	255 345	133 170	122 175	225 545	125 120	100 425	29 800	8 050	21 750
1960	268 435	139 560	128 875	236 235	130 585	105 650	32 200	8 976	23 226
1961	283 740	146 935	136 805	248 750	136 895	111 855	34 990	10 040	24 950
1962	299 910	155 580	144 350	261 685	144 100	117 585	38 225	11 480	26 765
1963	316 010	163 330	162 680	275 005	150 785	124 220	41 005	12 645	28 460
1964	331 640	170 590	160 950	287 855	157 050	130 805	43 785	13 640	30 145
1965	348 050	178 290	169 780	301 280	183 490	137 790	46 770	14 800	31 970
1966	387 310	187 310	180 000	317 576	171 680	145 895	49 735	15 830	34 106
1967	385 585	195 000	190 565	333 075	178 775	154 300	52 490	18 225	36 265
1968	402 965	201 930	201 035	347 790	185 150	182 840	55 175	18 780	38 396

●See also Table 34.

Sources: Ministry of Technology

Part three Survey in relation to other data

Survey in relation to other data

8 Integration of survey and census data

8.1 Part Three discusses how survey data on QSEs have been combined with estimates from the Censuses of Population to make an overall assessment of the changes in numbers in employment in Great 8ritein from 1959 to 1968.

8.2 The major source of dete on numbers of QSEs *in employment* ere the results of the voluntary, employer-based surveye cerriad out every three years since the pioneer survey in 1956.[4] (The survey results and the methodology used in the most recent survey, Jenuary 1968, are given in full in Part Four.) The surveys provide data for manufecturing, construction, Government departments, research councils and locel authorities, education, nationalized industries end public corporetions and industriel reseerch associations.

8.3 For sectors not covered by the manpower surveys the Censuses of Population provide estimates for 1961 and 1966. Methods derived from the generalized flow models described in Pert Two have been used to make estimates for the 'survey' years. Finelly, the link between the estimates of numbers of QSEs in employment and the estimates of numbers of QSEs who ere economicelly active (es in Part Two) is illustrated in Teble 43.

8.4 It will be noted thet, wherees between the Censuses of Population years 1961 and 1966 there is an ebsolute constraint on the estimates made, the situation is different for the yeers back to 1959 and forward to 1968. For these two periods there is, however, first the overall constraint of the flow models, the checks available from study of densities (Section 13) and the DEP occupational date (Section 14).

9 QSEs in manufacturing

9.1 The principles accepted in lining up census end survey points are defined for manufacturing as e whole. The series for each industry of interest are derived initially using the same basic methods and then adjusted slightly to fit into the aggregate series. The classification by SIC makes it possible to line up the reporting units from the manpower surveys with the analysis by industry from the Censuses of Population.

9.2 The principle is accepted that all data, both for censuses and surveys, mey be edjusted in deriving the combined series. This principle derives from the fact that all the deta are subject to sampling errors. In the 1961 census publication, the then General Register Office gave the following indicator:

> *'Example:* Sample figure 889 will be referred to as 8890. Rough estimate of sample error is the square root of 889 or 30 end as e proportion this is (30 × 100)/889 = 3·4 per cent. The odds are 20: 1 that the true figure for the population as e whole lies in the range 8890 ± 2(300) or 8290 to 9490 (6·7 per cent either way).'

Adjustment of 1959 dete

9.3 The first move is to adjust the deta from the 1959 survey to a coveraga comparable to that given by the 1962 and subsequent surveys for establishments employing 11 or more persons. This hes been done in two stages; first, QSEs holding qualifications in agriculture and in textiles, plastics and rubber technology are estimated sector by sector from the deta

Estimation of QSEs in establishments employing 11-99 pereons in 1959*

Teble 37	Totel employees		Chenge per month = x	Estimeted totel employeee		QSEs in 1962	Density in 1862
	Jen 1968	June 1961		1959	1962		
Establishments employing 11-99 persons	1 600 650	1 641 970	—1 813	1 696 360	1 652 850	8 182	0·495

*Total menufacturing calculated for illustrative purposes only i.e. not equal to sum of seperate industries

Source: Ministry of Technology

Assuming density of QSEs constant in 1959 end 1962,

QSEs in esteblishments employing 11-99 persons in 1959 = $1\,696\,360 \times \frac{0{\cdot}495}{100}$

= 8 397

∴ QSEs in establishments employing 11 or more persons in 1959 = 64 317+8 397

= 72 714

given for the 1962 survey; second, the numbara of QSEs in establishments employing 11-99 persons are estimeted as shown in Table 37 using data for numbers of totel employees.

9.4 Tha two adjusted census points end the series of four survey points (including the adjustad point for 1959) ara shown in the chart. A first examination suggests that, between 1961 end 1966 at leest, tha two series converge. Thera is no evidenca to suggest that this tendancy began in 1961 and stopped in 1966. The convergenca is most probably e combination of progressively less under-enumeration in the surveys and decreasing numbers of QSEs employed by 'employers employing less than 11 persons' and/or less self-employed in manufacturing but there ie no evidence to suggest the relative weight of thase factors.

9.5 In the absence of any evidence to tha contrary, it is essumed that, between 1961 and 1966, the ratio of census to survey (or total QSEs to those in establishments employing 11 or more persons) dacreases in a linear manner end that whare S_i = survey estimate in year i and C_j = census estimate, bias corrected in year j.

$$S_{61} = S_{59} + \frac{28}{36}(S_{62} - S_{59})$$

$$S_{66} = S_{65} + \frac{16}{36}(S_{66} - S_{65})$$

then tha retios, census to survey in 1961 and 1966, ara given by

$$r_{61} = \frac{C_{61}}{S_{61}} \text{ end } r_{66} = \frac{C_{66}}{S_{66}}$$

end for the survey yeers 1962 end 1965 are given by

$$r_{62} = r_{61} - \frac{2}{15}(r_{61} - r_{66})$$

end $r_{65} = r_{61} - \frac{11}{15}(r_{61} - r_{66})$ respectivaly.

9.6 If it is assumed that the trend in the ratio of tha numbers of QSEs in establishments employing less than 11 persons/salf-employed had begun before 1961 than tha ratio for 1959 may be derived by a linear extrapolation of the 1966 to 1961 trend:

r_{59} is then given by $r_{61} + \frac{7}{15}(r_{61} - r_{66})$

9.7 It saems unlikely that the two series will converge indefinitely, particularly in e merket situation of increasing supply of QSEs; indeed it is more probabla that thay mey begin to divarge et some point beyond 1966. Thus, in the absenca of eny evidence to the contrary, e constant retio is assumed between census 1966 and Jenuary 1968 and thet $r_{66} = r_{66}$.

9.8 The resultant series appeers visuelly to ba very close to a straight line (see chart). However, es will be saen from Table 38, the net addition to the number of QSEs betwean tha survey dates ahows, in absoluta numbers, a fall between 1962 and 1965 end a recovery 1965 to 1968 or, in parcentege tarms, a fall in 1962 to 1965 to a rate which is meinteined from 1965 to 1968.

9.9 It will be observed that, throughout the process of combining the two serias, the census 1961 point has been left at the lower, edjusted level and the cansus 1966 point at tha higher, edjusted leval. Although the potential for adjusting either figure, with e preference for 1966, has been kept open, a consistent series has emergad without needing to make this reedjustmant. In tha prasent conjunction of date, eny 'adjustment-beck' of aither census point, apart from distorting the smooth flow of the combined saries, would imply greater convergence of the two original series (or greater rate of decreasa in tha retio of QSEs in small firms and/or self-amployad). Since there is no direct evidence to justify such a mova it is concluded that the proposed simpla curve is the best fit that can ba made with the data available, subject only to scrutiny of the overall pictura of deployment in ell sectors.

9.10 With tha exception of the 1959 total in Teble 39 and tha value calculeted in Teble 38 the figures show minimal differences, nevar greater then the 60 for 1968. The larger differanca for 1959 erises from the adjustmant upwards to compensata for ralative understatement in tha survey data for that year which became apparent from the flow models (see also Section 11).

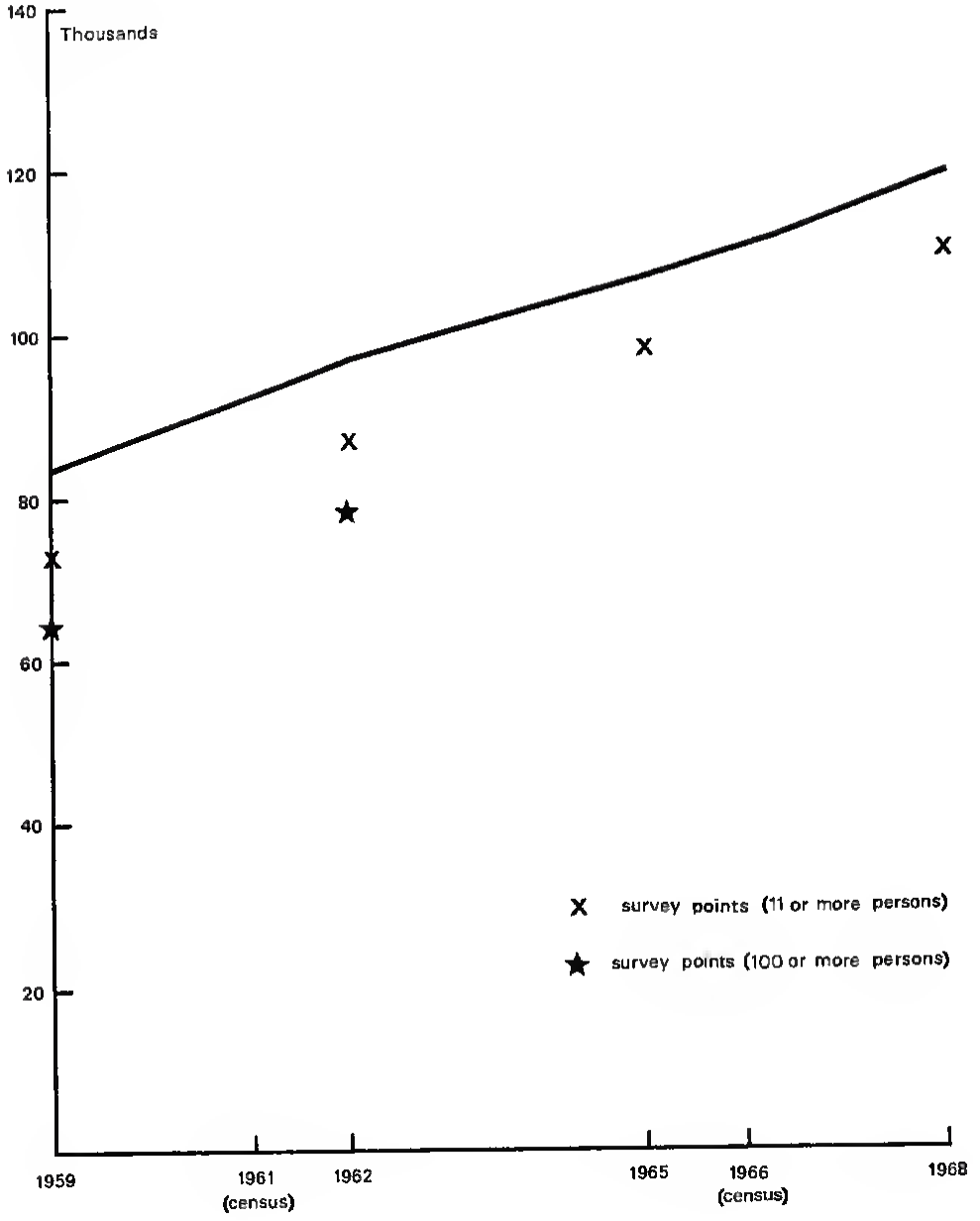
Calculation of new series with adjusted census data

Table 38	Census unadjusted dsts	Census adjusted dsts	Survey	Estimsted 'survey'	Ratio Census: survey	Ratio Estimsted	Census coversge at survey yesrs	Growth between surveys	
	C_j	C_j	S_i	S_i	r_j	r_j		*Number*	*Per cent*
1959			*[72 714]			1·1548	83 970		
1961	97 140	94 175		83 222	1·1316				
1962			96 221			1·1250	96 999	+13 029	*+15·5*
1965			98 540			1·0951	107 911	+10 912	*+11·2*
1966	109 740	112 715		104 195	1·0918				
1969			111 276			1·0818	120 379	+12 467	*+11·5*

*Estimated in Table 37.

Source: Ministry of Technology

Manufacturing



Employment of OSEs in manufacturing[1]

Table 39	1959	1961 Census	1962	1965	1966 Census	1968
ALL SUBJECTS						
All manufacturing	**85 580**	**84 175**	**97 040**	**107 840**	**112 715**	**120 440**
Food, drink and tobacco	3 050	3 315	3 460	4 390	4 560	4 775
Chemicals and allied industries	17 550	19 145	19 405	21 160	22 085	23 565
Metal manufacturing	5 360	8 390	6 605	7 535	7 845	7 850
Machine tools	1 460	1 550	1 530	1 805	2 150	2 485
Scientific instruments	2 500	2 530	2 515	2 665	2 725	2 710
Other mechanical engineering	15 830	17 425	17 705	19 825	20 565	21 495
Electrical engineering and electronics	16 240	19 065	20 360	23 690	25 530	27 770
Aircraft	8 895	8 930	8 750	7 965	7 925	8 125
Motor vehicles	2 930	2 805	2 760	3 685	3 720	3 850
Other vehicles	2 170	2 395	2 515	2 275	2 645	3 055
Textiles, clothing, etc.	4 050	4 125	4 345	4 675	4 870	5 300
Other manufacturing	5 445	5 490	5 990	6 270	8 495	9 480
ENGINEERING AND TECHNOLOGY						
All manufacturing	**58 120**	**64 135**	**66 550**	**72 430**	**75 455**	**80 030**
Food, drink and tobacco	955	1 060	1 165	1 430	1 440	1 620
Chemicals and allied industries	5 950	6 720	8 980	7 520	7 685	7 915
Metal manufacturing	4 320	5 130	5 380	6 230	6 205	5 225
Machine tools	1 360	1 480	1 550	1 720	2 050	2 315
Scientific instruments	1 335	1 505	1 580	1 820	1 695	1 705
Other mechanical engineering	14 080	15 380	15 615	17 325	18 080	18 900
Electrical engineering and electronics	12 555	14 465	15 490	17 110	18 510	20 030
Aircraft	7 175	7 445	7 366	8 805	6 545	6 680
Motor vehicles	2 735	2 670	2 630	3 375	3 370	3 440
Other vehicles	2 115	2 305	2 405	2 115	2 360	2 700
Textiles, clothing, etc.	2 355	2 380	2 520	2 615	2 535	2 875
Other manufacturing	3 185	3 815	3 880	4 765	4 880	5 625
SCIENCE						
All manufacturing	**27 460**	**30 040**	**30 490**	**35 510**	**37 260**	**40 410**
Food, drink and tobacco	2 095	2 255	2 295	2 960	3 120	3 155
Chemicals and allied industries	11 700	12 425	12 445	13 640	14 400	15 650
Metal manufacturing	1 040	1 250	1 225	1 305	1 440	1 625
Machine tools	100	80	70	85	100	170
Scientific instruments	1 165	1 025	935	1 045	1 030	1 005
Other mechanical engineering	1 750	2 045	2 090	2 500	2 485	2 595
Electrical engineering and electronics	3 685	4 600	4 870	6 580	7 020	7 740
Aircraft	1 720	1 485	1 385	1 360	1 380	1 445
Motor vehicles	185	135	130	310	350	410
Other vehicles	55	90	110	150	285	355
Textiles, clothing, etc.	1 895	1 755	1 825	2 060	2 035	2 425
Other manufacturing	2 260	2 875	3 110	3 505	3 515	3 835

[1] With the exception of the census figures, the other estimates above relate to January. It is known that January employment is slightly higher overall than in April because of deaths and retirement in the first 17 weeks of the year. It follows that the estimates above, which are based on April census figures, have slightly underestimated the January employment in small establishments and the self-employed.

Source: Ministry of Technology

10 Public sector employers and construction firms

10.1 These ere discussad in four groups:

Group I *Government and research*
Government departments
The Armed Forces
Research councils
Industrial research associations

Group II *Local authorities and construction*
Locel authorities (excluding teachers)
Construction firms

Group III *Nationalized industries and public corporations*

Group IV *Education services*

Groups I end II

10.2 These groups are discussed together becausa they stand et the main conjunction of the employer: SIC matrix; that is to say, the two large employers, Governmant and local authorities, employ QSEs in places of work which span more than one MLH heading while two others, research councils and IRAs, fall into MLHs shared with sub-divisions of these lerge employers. There are also small elements of private employers in all thesa MLHs. Construction is included because a lerga part, approximately 25 per cent of the QSEs in MLH 500, ara employed by local authorities.

10.3 Essentially the problem erisas because the censua data are coded to industry whereas the employer survey forms are coded (automatically) to the employer but not to industry. Only in 1962 was there a follow-up enquiry to all larga employers collecting details of the breakdown of the total QSEs employed by the identity of the industry in which they worked. Until coding of the deta collected by the Census of Population includes identificetion of establishments belonging to public employars, there will be no completely satisfactory way of daaling with these SIC headings.

10.4 For these raasons it has been usual in a eector analysis of manpower stetistics to present 'Governmant and rasearch', with or without the Armed Forces, as one group and, for tha presant purposes, a further group 'Locel authorities and construction' has baen adopted. Then, substantielly, the two groups of employars are equivalent to MLHs 879/2 and 901 on the one hand and MLHs 500 and 906 on the other end tha dovetailing of census and survey data into one series for 1959 to 1968 bacomes a feesible proposition. As explained in tha following paragraphs, tha ettempts to disentangle the two exes, industry and type of employar, are carriad out meinly to validete these groups es a whole end es part of the total estimates of QSEe in employment. The sub-division by SIC is of less importance.

10.5 The fit is imperfect in two respects:

(a) Some QSEs employed by these large amployers were coded in in tha census to MLHs outsida those chosen to define Groups I to III, e.g. in Group I, QSEs employed in Government establishments (ROFs) were coded to industry; QSEs employed by MRC were coded to Medical services end in Group II QSEs employed by local authorities were coded to Transport MLH 702 or Education administration MLH 872.

(b) The MLHs defining Groups I to III include in the census some QSEs not employed by the large amployers, e.g. private/independent research establishmants coded to MLH 879/2.

10.6 The differences amount to a small proportion of total QSEs in employment and represent e small margin of impracision arising from the method described below.

Methods used

10.7 For the purposes of the current analysis, en epproximate fit of census and survey has been derived by the following method. The allocation of employer data to MLHs hes been resolvad by the use of employer/SIC metrices constructed discipline by discipline for this purpose. The starting point was a 6×4 matrix where the 6 rows represent the 6 employers listed under Groups I end II and the 4 columns represent the four dominant MLHs. To complete tha SIC picture, edditional columns were added to accommodate all the MLHs into which QSEs employed by thase employers may fall. Similarly, to completa the employer picture, additionel rows were edded to cover all employers whose QSEs fell into these MLHs represented by the columns. One further row was added to accommodate the residual, private/self-employed/small firms.

10.8 For eech discipline the figures in the rows were first constructed for 1962. In this yeer a special follow-up enquiry to all larga employers collected details of the breakdown of the total QSEs employed into MLHs. These data gave ell the entries for the non-zero cells in those employar rows; it was eseumed that ell other cells in thesa rows ware zero. The distribution of non-zero cells reflects the diversificetion of the employers' activities. Similarly the column totals reflect the employer participation within each MLH. In deriving the corresponding row or column entries for the years 1959, 1965 and 1968, tha simplest assumption has been made that the pettern of diversification ramained tha same and thet the non-zero cells are repaeted in these yeers.

10.9 For ell MLHs othar than MLH 500, construction, independent estimates of the column totals were calculatad using the 1961 end 1966 censua figures and a linear interpolation/extrapolation for 1959, 1962, 1965 end 1968. Construction, being dominated by the construction firms covered by the

survey, was calculated using the ratio method outlined for manufacturing. In other words it was assumed that the numbers of QSEs employed in establishments other than in these firms, follow the pattern of employment of QSEs given by the 'survey data'.

10.10 The estimated column totals were then checked for compatability with the summation of the non-zero cells indicated by the employer (row) data. Two MLHs, 901 and 906, take up the largest share of the number of QSEs returned by Government departments and local authorities respectively. The estimates for the other non-zero cells in 1982, derived from the follow-up enquiry, give an indication of the allocation to MLHs of the remaining QSEs employed. Each column carries a residual, private/small firms/self-employed, which takes up the difference between the column total and the aggregation of the other non-zero cells. Only in construction, MLH 500, was it necessary to raise the column total for 1968 to accommodate the aggregation of the cell data.

10.11 The corollary to these methods is that estimates for certain industry MLHs outside Groups I and II include, as a residual, a very small allowance for Government departments but this is in all cases very minor and will have no significant influence on the total.

Group III Nationalized industries and public corporations

10.12 The MLHs into which these employers fall present a much simpler problem of estimation. In all these industries one or more public corporations or boards predominate. The QSEs in the remaining privately owned firms have been estimated in all cases by using the ratio method outlined for manufacturing and checking the estimates so obtained against the flow models (see Section 11).

Group IV Education

10.13 The estimate of the employment of QSEs in education services, MLH 872, was provided by the Department of Education and Science. Information collected on teaching staff by the Department of Education and Science and the Scottish Education Department and on non-teaching local authority staff by DEP has been used with estimates from the 1966 Census of Population to construct a series of employment of QSEs in MLH 872 from 1959 to 1968. The main component of this series is an annual survey figure of teaching staff with the relevant qualifications. The addition for the non-surveyed sector embodies the assumption that the density of QSEs in this sector has remained constant throughout the period at a level estimated for 1966.

10.14 This series has a wider coverage than the triennial survey which covered full-time teachers in primary, secondary, further and higher education together with education administration in Scotland and non-teaching staff in universities.

10.15 The final series of estimates for education and the other broad sectors are shown in Table 40.

11 Flow data for unsurveyed sectors

11.1 The sectors which fall into this group are those for which estimates of total numbers of QSEs in employment are given by the Census of Population in 1961 and 1966 but for which there are no returns (or insufficient returns) from employers to guide estimates for the survey years. These sectors are:

Agriculture
Distributive trades
Insurance and banking
Scientific and technical services
Medical services
Other professional and scientific services
Miscellaneous services.

11.2 It should be noted that in two sectors, agriculture and medical services, QSEs represent a minority group within the total of highly qualified manpower employed (i.e. all persons holding degrees or equivalent qualifications irrespective of subject). It is estimated that in 1966 there were 8000 highly qualified persons employed in Order I compared with 3735 QSEs: in addition there were 3400 holders of diplomas in agriculture. In medical services the ratio of highly qualified manpower to QSE is much more marked: there were, it is estimated, 82 000 highly qualified persons in 1966 of which only 9610 were QSEs. And, of these, many had proceeded to medical degrees.

11.3 For each sector or group of sectors, the flow data have been brought together into a simplified flow model. The basic principle underlying the whole exercise also applies here viz. that the interval between the census benchmarks, the intercensal period, is used to derive transition coefficients which may be applied, with or without a modifying factor, to years outside these limits.

Flows identified in the models

11.4 The flows applicable to the total stock of QSEs, new supply, deaths and migration are discussed fully in Part Two. However, in the sector models, flows between sectors must be taken into consideration. These include mobility due to the normal circulation or job progression of individuals and other intersector transfers reflecting the growth (or decline) of the industry in question.

11.5 In identifying the components of the total flows into and out of each sector, the concept of mobility is considered and analysed in terms of the

principal motivating forces. In the models it has been found necessary to distinguish (i) the element of mobility which constitutes the normal circulation of individuals requiring wider experience and (ii) the mobility which results from the creation of new posts in an expanding industry and the loss of posts in a declining one.

Normal circulation or job progression

11.6 It is estimated that, in a stable situation in any sector, there is a continuing circulation level of people wishing to change jobs who choose to do so by also changing employer. Most of these moves will take place within the same sector, some will take place between sectors; the latter is termed normal circulation. The divisions between these two, and therefore the contribution to intersector flows, will clearly depend on the breadth of the sector under consideration. A 'normal' circulation equivalent to 2 per cent has been found consistent with other flows. This is apparent even when the employment of QSEs is declining overall.

Growth or decline

11.7 Mobility under these headings is a direct result of the economic climate of the sector; it is defined as any circulation, in or out, above normal circulation. The factors which will induce a significantly large movement under either heading are a strongly growing industry, such as electronics, or a consistent decline in fortunes, such as has been experienced in recent years by agriculture or mining.

11.8 The introduction of the concept of the 'normal circulation' has a number of advantages:

(a) By recognizing that there will be a continual outward flow (over and above natural wastage), even in a growing population, it gives a better balance of flows and thus makes the measure of recruitment to the sector more realistic.

(b) It enables the recruitment of QSEs to the sector to be analysed into the three elements, replacement of natural wastage, normal circulation and growth; while the QSEs leaving posts in a sector can be analysed into deaths, retirements, normal mobility and redundancy. It is important to realize that QSEs who emigrate can be found under either of the two latter headings.

(c) The ability to identify (even approximately) the recruitment attributable to growth is important for all economic studies and for manpower projections in an industry.

Recruitment of persons with new qualifications

11.9 The numbers of persons obtaining first degrees and higher degrees and then accepting posts in each sector are given in reports of 'first employment' from the University Grants Committee.[12] Throughout the period 1959 to 1968 there has been an improvement in the quality of these data. Numbers for each discipline are sub-divided into a number of broadly defined groups. These groups are not always coincident with the SIC orders and, consequently, some have to be combined to accommodate these data (these groupings are shown in the Appendix, Section 22). Information on the flow into employment of new members of professional institutions is obtained from the professional institutions and the number allocated to the sectors each year is estimated for each group of disciplines.

Migration

11.10 The estimates for each sector are derived from the series of total emigration or immigration. Since the pattern of migration varies discipline by discipline, the estimates include a separate assessment for any discipline which is dominant in a particular sector.

Demographic mobility or natural wastage

11.11 Deaths and retirements or withdrawals from employment are included under this heading. The relatively larger numbers of women QSEs in science are reflected in these data. A proportion withdraw from employment on marriage, followed by a corresponding return into the active population at a later age.

Flows in from other sectors

11.12 An estimate of net growth in a sector between 1961 and 1966 is given by the intercensal residual. If estimates for new supply and immigration are deducted from this residual then the difference represents deaths, retirements, and non-demographic wastage including emigration and flow out to other sectors. The total outflows are given by deaths and retirements, and wastage to other sectors including emigration. The total inflows (other than from other sectors) are given by new supply and immigration. The difference between the last two estimates and the estimates of annual net growth represents the shortfall which is taken as being covered by recruitment from other sectors. The latter are then set against the aggregation of the circulatory wastage from other sectors.

11.13 The flow models have also been used to make a further study of the estimates obtained by the methods described in Section 10. For example it has been found that the estimates for the combined group 'Government and research' are consistent with the results obtained from using the flow model. Further details of the flow data are given in the Appendix, Section 22.

Employment of QSEs in all sectors[1]

Table 40	1959	1961 census	1962	1965	1966 census	1966
ALL SUBJECTS						
All sectors	222 140	248 320	258 040	296 470	311 970	341 665
Manufacturing	85 580	94 175	87 040	107 940	112 715	120 440
Government and research	23 010	25 115	26 480	29 315	29 980	32 580
Local authorities and construction	14 000	15 600	16 715	20 535	22 085	25 405
Scientific and technical services	7 870	8 730	9 280	10 440	10 405	10 930
Public utilities	15 000	18 880	17 605	20 785	21 765	25 110
Mining and quarrying	4 580	3 980	3 760	3 810	4 225	3 890
Agriculture	5 270	4 700	4 525	3 915	3 735	3 450
Education	44 990	50 185	52 660	80 705	85 740	71 145
Commerce	5 770	6 855	7 460	9 175	9 485	10 945
Accountancy and legal services	480	815	710	1 030	1 115	1 430
Medical services	7 195	7 995	8 310	9 410	8 610	10 390
Other	8 295	11 510	13 495	18 410	21 120	26 170
ENGINEERING AND TECHNOLOGY						
All sectors	123 195	135 635	142 165	160 915	166 670	183 080
Manufacturing	58 120	64 135	66 550	72 430	75 455	80 030
Government and research	12 045	12 705	13 165	14 320	14 350	15 160
Local authorities and construction	13 400	14 740	15 700	19 045	20 270	23 200
Scientific and technical services	7 200	7 755	8 185	8 115	8 110	9 445
Public utilities	14 020	15 460	16 980	18 235	18 790	21 150
Mining and quarrying	3 890	3 450	3 250	3 290	3 680	3 280
Agriculture	800	685	830	870	890	730
Education	6 935	7 935	8 825	10 130	12 090	13 540
Commerce	3 320	3 830	4 155	5 040	5 120	5 775
Accountancy and legal services	55	90	110	240	265	410
Medical services	280	370	415	600	625	720
Other	3 330	4 560	5 390	7 800	8 125	9 840
SCIENCE						
All sectors	98 945	110 685	115 875	135 655	143 400	158 806
Manufacturing	27 460	30 040	30 480	35 510	37 260	40 410
Government and research	10 965	12 410	13 315	14 985	15 640	17 420
Local authorities and construction	600	880	1 015	1 490	1 815	2 205
Scientific and technical services	770	975	1 085	1 325	1 295	1 485
Public utilities	980	1 400	1 825	2 550	2 975	3 960
Mining and quarrying	690	510	510	520	545	610
Agriculture	4 670	4 115	3 895	3 245	3 045 [2]	2 720
Education	38 055	42 250	44 035	50 575	53 650	57 805
Commerce	2 450	3 025	3 305	4 135	4 345	5 170
Accountancy and legal services	425	525	600	790	850	1 020
Medical services	8 915	7 625	7 895	8 810	8 985	9 870
Other	4 985	6 950	8 105	11 610	12 995	16 530

[1] With the exception of the census figures, the other estimates above relate to January. It is known that January employment is slightly higher overall than in April because of deaths and retirement in the first 17 weeks of the year. It follows that the estimates above, which are based on April census figures, have slightly underestimated the January employment in small establishments and the self-employed.

[2] Excludes 3 400 persons with diplomas in agriculture.

Source: Ministry of Technology

Distribution of QSEs in employment

Per cent

Table 41	1959	1961 census	1962	1965	1968 census	1968
ALL SUBJECTS						
All sectors	100·0	100·0	100·0	100·0	100·0	100·0
Manufacturing	36·5	36·2	37·6	36·4	36·1	35·2
Government and research	10·4	10·2	10·3	9·9	9·6	9·5
Local authorities and construction	6·3	6·3	8·5	6·9	7·1	7·4
Scientific and technical services	3·6	3·5	3·6	3·5	3·3	3·2
Public utilities	6·6	6·9	6·6	7·0	7·0	7·3
Mining and quarrying	2·1	1·6	1·5	1·3	1·4	1·1
Agriculture	2·4	1·9	1·6	1·3	1·2	1·0
Education	20·3	20·4	20·4	20·5	21·1	20·6
Commerce	2·6	2·6	2·9	3·1	3·0	3·2
Accountancy and legal services	0·2	0·2	0·3	0·3	0·4	0·4
Medical services	3·2	3·2	3·2	3·2	3·1	3·0
Other	3·7	4·7	5·2	6·5	5·8	7·7
ENGINEERING AND TECHNOLOGY						
All sectors	100·0	100·0	100·0	100·0	100·0	100·0
Manufacturing	47·2	47·3	46·6	45·0	44·6	43·7
Government and research	9·6	9·4	9·3	6·9	6·5	6·3
Local authorities and construction	10·9	10·9	11·0	11·8	12·0	12·7
Scientific and technical services	5·8	5·7	5·8	5·7	5·4	5·2
Public utilities	11·4	11·4	11·2	11·3	11·1	11·6
Mining and quarrying	3·2	2·5	2·3	2·1	2·2	1·8
Agriculture	0·5	0·4	0·4	0·4	0·4	0·4
Education	5·6	6·6	6·1	6·3	7·2	7·4
Commerce	2·7	2·6	2·9	3·1	3·0	3·2
Accountancy and legal services	—	0·1	0·1	0·2	0·2	0·2
Medical services	0·2	0·3	0·3	0·4	0·4	0·4
Other	2·7	3·4	3·8	4·8	4·6	5·3
SCIENCE						
All sectors	100·0	100·0	100·0	100·0	100·0	100·0
Manufacturing	27·7	27·1	26·3	26·2	26·0	25·4
Government and research	11·1	11·2	11·5	11·1	10·6	11·0
Local authorities and construction	0·6	0·6	0·9	1·1	1·3	1·4
Scientific and technical services	0·8	0·6	0·9	1·0	0·9	0·9
Public utilities	1·0	1·3	1·4	1·9	2·1	2·6
Mining and quarrying	0·7	0·4	0·4	0·4	0·4	0·4
Agriculture	4·7	3·7	3·4	2·4	2·1	1·7
Education	36·6	36·2	38·0	37·3	37·4	36·3
Commerce	2·5	2·7	2·9	3·1	3·0	3·3
Accountancy	0·4	0·6	0·6	0·5	0·6	0·5
Medical services	7·0	6·9	6·6	6·6	6·3	6·1
Other	5·0	8·3	7·0	8·5	9·0	10·4

Source: Ministry of Technology

Growth in employment of QSEs

1959 = 100

Per cent

Table 42	1959	1961 census	1962	1965	1966 census	1966
ALL SUBJECTS						
All sectors	100·0	110·9	118·2	133·5	140·4	153·9
Manufacturing	100·0	110·0	113·4	128·1	131·7	140·7
Government and research	100·0	109·1	115·1	127·4	130·3	141·8
Local authorities and construction	100·0	111·4	119·4	146·7	157·8	181·5
Scientific and technical services	100·0	109·5	116·4	131·0	130·6	137·1
Public utilities	100·0	112·5	117·4	138·5	145·1	187·4
Mining and quarrying	100·0	86·5	82·1	83·2	92·2	84·9
Agriculture	100·0	89·2	85·9	74·3	70·9	65·5
Education	100·0	111·5	117·0	134·9	146·1	158·1
Commerce	100·0	118·8	129·3	159·0	164·0	189·7
Accountancy and legal services	100·0	128·1	147·9	214·6	232·3	297·9
Medical services	100·0	111·1	115·5	130·8	133·6	144·4
Other	100·0	138·8	162·7	234·0	254·6	315·5
ENGINEERING AND TECHNOLOGY						
All sectors	100·0	110·1	115·4	130·6	136·6	148·6
Manufacturing	100·0	110·3	114·5	124·6	129·8	137·7
Government and research	100·0	105·5	109·3	118·9	119·1	125·9
Local authorities and construction	100·0	110·0	117·2	142·1	151·3	173·1
Scientific and technical services	100·0	107·7	113·8	126·6	126·5	131·2
Public utilities	100·0	110·4	114·0	130·1	134·0	150·9
Mining and quarrying	100·0	88·7	83·5	84·6	94·6	84·3
Agriculture	100·0	97·5	105·0	111·7	115·0	121·7
Education	100·0	114·4	124·4	146·1	174·3	195·2
Commerce	100·0	115·4	125·2	151·8	154·2	173·8
Accountancy and legal services	100·0	163·6	200·0	436·4	481·8	745·5
Medical services	100·0	132·1	148·2	214·3	223·2	257·1
Other	100·0	138·9	161·9	234·2	244·0	289·5
SCIENCE						
All sectors	100·0	111·9	117·1	137·0	144·9	180·5
Manufacturing	100·0	109·4	111·0	129·3	135·7	147·2
Government and research	100·0	113·2	121·4	138·8	142·6	158·9
Local authorities and construction	100·0	143·3	169·2	248·3	302·5	367·5
Scientific and technical services	100·0	126·6	140·9	172·1	168·2	192·8
Public utilities	100·0	142·9	165·8	260·2	303·6	404·1
Mining and quarrying	100·0	73·9	73·9	75·4	79·0	88·4
Agriculture	100·0	88·1	83·4	69·5	55·2	58·2
Education	100·0	111·0	115·7	132·9	141·0	151·4
Commerce	100·0	123·5	134·9	168·8	177·3	211·0
Accountancy and legal services	100·0	123·5	141·2	185·9	200·0	240·0
Medical services	100·0	110·3	114·2	127·4	129·9	139·8
Other	100·0	140·0	163·2	233·8	261·7	332·9

Source: Ministry of Technology

12 Employment of QSEs in all sectors and link with economically active stock in January

12.1 A series of estimates for all QSEs in employment has now been estimated for the years 1959, 1961, 1962, 1965, 1966 end 1968 (Table 40). The distribution of the total number between the employing sectors is shown in Table 41 and the estimated growth from 1959 to 1968 in Table 42.

12.2 The link with the demographic or flow estimetes in Part Two is made by adding an estimate for the number out of employment (Teble 32) and a seasonel adjustment to bring the estimates onto a January basis. The estimetes of economically active stock in January so produced ere shown in Table 43.

12.3 The serias of activity retes *implied* by these estimates ara given in Part Two, Table 35 where, it will be noted, the analysis of stock is completed using these activity retes and, by implication, the estimates of numbers in employment from Tabla 40.

13 Density of QSEs

13.1 The estimated number of QSEs in employment ere shown in relation to total employment for each of the census and survey years. The ratios shown in Tables 44 and 45 are the number of QSEs per 100 persons in employment.

13.2 It should be noted that these density ratios differ from those given in Teble S9 of Part Four, in that the data in Table 44 relate to QSEs employed throughout menufecturing whereas the data in Table S9 relate only to those establishments employing 11 or more persons. It will be observed in comparing the density ratios in tha two tables that, in general, density of QSEs employed is greater in the larger establishments.

13.3 The figures of density are obtained from two sources:

(i) The direct estimates of employment in Tables 39 and 40, and

(ii) the estimated numbers of employees in Graat Britein in June of each yeer, published by the Department of Employment and Productivity (8). Since 1959 a number of changes have occurred in the employment series and the estimates as published heve therefora been 'spliced' to obtain a series of figures on e common basis. It follows thet the measurement of 'density' in Tables 44 and 45 is only approximate.

13.4 One aspect of the series is worthy of mention. It will be observed that the density measura for 1959 is frequently *higher* than that for 1961. While this may be due at least in part to sample error, it ia possible that the phenomenon reflects the economic boom of 1959 which brought a rapid increase in totel employment and thus e lower figure of density in 1961. (See also *Economic Trends*, Cyclas of industrial production.)

QSEs in employment

Link with economically active stock

Table 43	Engineering and technology				Science			
	In employment	Out of employment	Seasonel adjustment	Economically ective in Jenuery	In employment	Out of employment	Seasonel adjuetment	Economically ective in Jenuery
1959	123 195	1 215	710	125 120	98 945	1 215	285	100 425
1961	135 535	845	415	135 895	110 685	860	310	111 855
1962	142 155	1 355	580	144 100	115 875	1 350	360	117 585
1955	150 915	1 715	860	163 490	135 555	1 750	485	137 790
1955	158 570	1 845	1 265	171 580	143 400	1 800	595	145 895
1858	183 080	940	1 130	185 150	158 805	3 200	835	182 540

● See also Tables 29, 36 and 40.

Source: Ministry of Technology

Dansity of QSEs in amployment in manufacturing

Number of QSEs per 100 employees

Table 44	1959	1961 census	1962	1965	1968 census	1968
ALL SUBJECTS						
All menufecturing	0·999	1·047	1·083	1·195	1·246	1·375
Food, drink end tobecco	0·371	0·395	0·407	0·523	0·543	0·580
Chemicals end allied industries	3·368	3·572	3·703	4·069	4·175	4·557
Metal menufecturing	0·913	0·995	1·085	1·177	1·219	1·325
Mechine tools	1·090	1·033	1·032	1·101	1·265	1·470
Scientific instruments	1·936	1·698	1·699	1·766	1·817	1·831
Other mechenicel engineering	1·070	1·072	1·084	1·158	1·196	1·293
Electrical engineering end electronics	2·180	2·322	2·401	2·623	2·763	3·038
Aircraft	3·154	3·058	3·114	3·238	3·275	3·330
Motor vehicles	0·680	0·612	0·690	0 693	0·699	0·758
Other vehicles	0·508	0·516	0·676	0·782	0·945	1·189
Textiles, clothing, etc.	0·273	0·278	0·300	0·340	0·345	0·422
Other menufecturing	0·359	0·403	0·430	0·493	0·506	0·663
ENGINEERING AND TECHNOLOGY						
All menufecturing	0·679	0·713	0·743	0·802	0·834	0·914
Food, drink end tobecco	0·118	0·127	0·137	0·170	0·171	0·197
Chemicel end allied industries	1·135	1·254	1·328	1·446	1·453	1·564
Metal menufecturing	0·736	0·799	0·883	0·973	0·990	1·052
Mechine tools	1·015	0·980	0·987	1·049	1·206	1·370
Scientific instruments	1·035	1·010	1·088	1·073	1·130	1·162
Other mechenicel engineering	0·951	0·945	0·956	1·021	1·052	1·137
Electrical engineering end electronics	1·685	1·762	1·827	1·895	2·003	2·191
Aircraft	2·544	2·550	2·621	2·685	2·705	2·738
Motor vehicles	0·635	0·583	0·582	0·534	0·633	0·677
Other vehicles	0·495	0·593	0·647	0·727	0·843	1·051
Textiles, clothing, etc.	0·159	0·159	0·174	0·190	0·195	0·229
Other menufecturing	0·210	0·225	0·239	0·284	0·291	0·335
SCIENCE						
All menufecturing	0·321	0·334	0·340	0·393	0·412	0·461
Food, drink end tobecco	0·255	0·269	0·270	0·352	0·371	0·383
Chemicel end ellied industries	2·233	2·318	2·375	2·623	2·722	3·093
Metal menufecturing	0·177	0·195	0·201	0·204	0·230	0·274
Mechine tools	0·075	0·053	0·044	0·052	0·059	0·101
Scientific instruments	0·903	0·688	0·532	0·692	0·687	0·679
Other mechenicel engineering	0·118	0·126	0·128	0·147	0·145	0·156
Electrical engineering end electronics	0 495	0·560	0 574	0·728	0·760	0·847
Aircraft	0·610	0·509	0·493	0·653	0·570	0·592
Motor vehicles	0 045	0·029	0·028	0·058	0·066	0·081
Other vehicles	0·013	0·023	0·030	0·055	0·102	0·138
Textiles, clothing, etc.	0·114	0·119	0·125	0·150	0·150	0·193
Other menufecturing	0·149	0·179	0·191	0·209	0·215	0·228

Source: Ministry of Technology

Changa in dansity of QSEa in employad work forca of Graat Britain

1959 to 1968

Table 45	Employed work force (thousends)	QSEs in employment in all sectors	QSEs per 100 of employed work force
1959	23 807	222 140	*0·93*
1960	24 229	233 290	*0·96*
1961	24 518	246 320	*1·00*
1962	24 674	258 040	*1·05*
1963	24 677	259 155	*1·09*
1964	24 951	282 650	*1·13*
1965	25 193	296 470	*1·18*
1966	25 330	311 870	*1·23*
1957	24 926	326 655	*1·31*
1968	24 728	341 885	*1·38*

●See also Tebles 34, 36 end 40.

Sources: Ministry of Technology
Employment end Productivity Gazette

14 Scientists and technologists by occupation

14.1 The annuel astimates of scientists and technologists *by occupation* are made by the Department of Employment end Productivity. The questionneire addressed to employers states:

> 'For the purpose of these enquiries scientists and technologists are defined as 'persons engaged on, or being trained for, work for which the normal qualification is a university degree in science and technology end/or membership of en appropriate professionel institution, e.g. A M I Mech E, Menegers and technical directors possessing such quelifications should be included under 'Managers etc.'

14.2 It follows that the statistics obtained from the DEP enquiry exclude from this heading those QSEs whose occupation is, for example, manager, technical director or technician, and conversely may *include* persons working as scientists end technologists who do not hold qualifications which group them es QSEs under the Census of Populetion or the 'manpower surveys'.

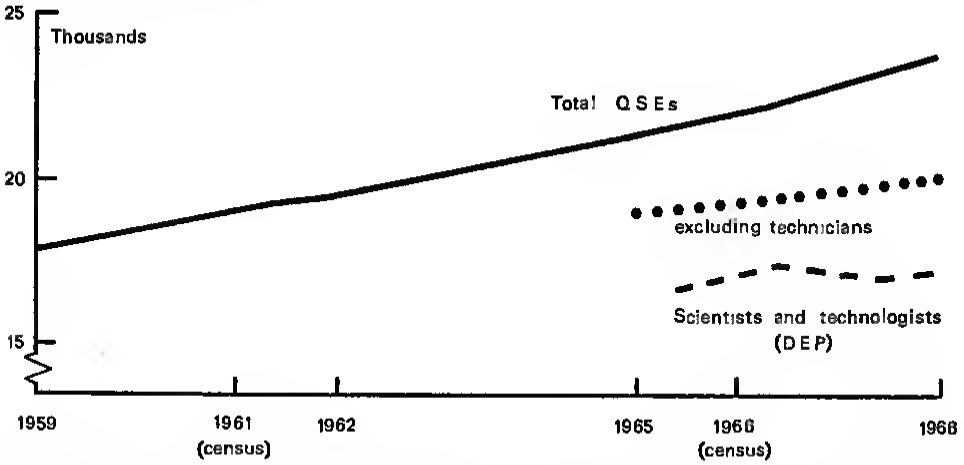
14.3 The effect of this different basis of meesurement is shown in a comparison between the number of QSEs and the occupation statistics (DEP) in the chemicals and allied industries. To obtein e better comparison, QSEs working as technicians (Table S17) are first removed from the survey data.

14.4 The totel number of QSEs is greater than the totel number of scientists and technologists in the DEP statistics, despite the inclusion in the letter of persons without QSE qualifications. This would seem to suggest that the numbers of QSEs employad *outside* the scientist end technologist occupetions, for example es managers, are more then sufficient to counterbalance the non-qualified persons employed as scientists and technologists. A subsidiary reason is that the DEP estimetes exclude scientists and technologists working in establishments with less than 11 employees.

14.5 Table 46 eummarizes the data collected each May in the ennual survey of occupations by the Department of Employment and Productivity between 1965 and 1968.

Census points end cslculated veluas for QSEe compared with occupation data

Chemicels end ellied industriee



Tha eetimsted numbar of employees who are engineers, sciantiete and tachnologiete by occupetion

Establishments with 11 or more employees — May of each year

Table 46	1965	1966	1967	1988
Aii menufecturing	82 770	88 400	93 370	85 050
Food, drink end tobacco	2 740	2 760	2 860	2 980
Chemicels and allied industries	15 570	17 350	16 970	17 260
Mechanical engineering and metel goods	13 550	15 110	16 620	17 240
Electricel and electronic engineering	25 070	25 510	28 460	29 330
Metel menufacture	5 420	5 440	5 510	5 550
Shipbuilding end merine engineering	970*	1 060	1 280	1 490
Vehicles	10 330	11 670	12 630	13 000
Textiles	2 900	3 000	3 000	3 030
Other manufecturing	5 220	5 480	6 040	5 050

* Partly estimated

Source: Department of Employment and Productivity

Part four
The 1968 survey

The 1968 survey

15 Purpose of the survey

15.1 A further voluntary, employer-based survey of persons holding degree or equivelent qualifications in engineering, technology and science was carried out jointly by the Ministry of Technology and the Department of Employment and Productivity in Jenuary 1968.

15.2 The main purposes of tha survey were:

(a) to extend a serias of data which began with the 1956 survey [4–7]: and

(b) to collect employers' estimatas of requirements three yeers ahaad.*

The importance of these data lies in their contribution to forward projections from the two axisting benchmarks given by tha Cansus of Population 1961[1] and the sample Cansus of Population 1966[3], to the date of the next Cansus of Population in April 1971.

15.3 The January 1968 survey was, therefore, essentially a repeat operation and every effort wes made to ensure comparability with the pravious surveys. At the planning stage the need for adjunctive data (such as an extended analysis by function in tha manner being explored by Ministry of Technology or a range of qualifications and subjects extended into tha fiald of arts or social sciences) was discussed at length but proposals to expand the questionnaire to meet these raquirements wera rajected on two grounds:

(a) the lack of time end staff available to plan and pilot such an extended questionnaire;

(b) tha priority need to maintain the original series of deta using the limited resources available.

15.4 The January 1965 survey[7] hed been used to collact, for the first time, data on the technicians or technicel supporting staff associeted with the employment of the qualified manpower. The question wes posed in the form of a second table, Table '8', which esked employers for tha number of persons *working* as technicians or in other technical supporting rolas. Since, by definition, it was possible for persons to be in Table '8' by type of work and also in Tabla 'A' by quelificetion, Table '8' included analysis by qualification in ordar to estimete tha overlap between the two teblas. This table was repeated in the 1968 survey to provide comparable data with that obtained from the 1965 survey and an estimate of change between these datas.

*See also Section 17 end definitions end notes to questionneire.

16 Conduct of the survey

16.1 The effective date of the survey was chosan as 13 January to coincida with tha Departmant of Employment and Productivity's employmant returns from firms in menufacturing on which were based tha control deta for total amployeas. Employers in other sectors ware asked to complete a return for this date or any other dey in January which was mora convenient to them.

Coverage

16.2 A total of 11 000 quastionnaires wara daapatched to tha following groups of amployars:

	Number of questionnaires deapatched
Government departments	145
Research councils	10
Local authorities	1 669
Education sector	3
Industrial reserch associations	71
Independent research establishments	49
Nationalized industries and public corporations	182
Menufacturing establishments	7 761
Construction firms	613
Menegement consultents	17
Consulting engineers	286

16.3 The main omissions ara:

Agriculture, forestry, fishing
Mining and quarrying (other than Netional Coal Boerd)
Docks and harbours
Distributive trades
Insurance, banking and finance
Medical and dental services
Private professional persons
Manufacturing establishments employing less then 11 persons
Construction firms employing less then 35 persons; (in 1965 firms employing less than 30 persons).

16.4 Manufacturing and construction wara covered by a sample enquiry. In the case of manufacturing, questionnaires were addressed to all establishments in England employing 500 or more persons (200 or

more in Scotlend and Wales)* and in construction to all firms in Great Britein employing more than 600 persons. In both industries proportions of the smaller establishments or firms were also covered. The details of the sampling fractions for both industries are given in Tables 47 end 48.

Sampling fractions in the 1968 survey

Menufacturing

Teble 47	Englend	Scotlend	Weles
Size renge of totel employees			
11— 49	1 in 48	1 in 24	all
50— 99	1 in 16	1 in 8	all
100—199	1 in 12	1 in 2	all
200—499	1 in 2	all	all
500 and over	all	all	all

Construction

Teble 48	Great Britein
Size renge of totel employees	
35— 59	†43
60— 79	1 in 21
80—114	1 in 14
115—299	1 in 7
300—599	1 in 2
600—1 199	all
1 200 and over	all

† 10 civil engineering firms.
10 electrical contracting firms.
10 construction engineering firms.
10 heating and ventilating engineering firms.
3 reinforced concrete specialists.

16.5 In other fields of employment questionnaires were sent to all known employers. The establishments covered by the survey employed in all some 74 per cent of the total GSEs in employment.

Pre-field steges

The questionnaire

16.6 In the interests of comparability of data no basic changes were mede to the questionnaire or accompanying definitions. Nonetheless, considereble detailed study was undertaken by the Ministry of Technology end the Department of Employment end Productivity in consultation with the Confederation of British Industries to improve the clarity of the wording used and to remove some of the embiguities in the 1965 survey. Special attention was given to the definitions of techniciens; the Industrial Treining Boards were eble to help with exemples of jobs filled by these persons.

Mailing lists for groups other than manufacturing and construction

16.7 The combined resources of the two Depertments were used to check and update the lists used in the 1965 survey. Lists for consultants, research associetions and independent reseerch esteblishments were included to complete the coverage of industry in the broedest sense. Two other lists were compiled in the course of the field stages end were followed up with requests to complete returns. These were:

(a) seperete research esteblishments;

(b) locel authorities likely to employ technicians in schools.

The problem of composite returns

16.8 Up to end including the 1966 survey there waa an increasing tendency on the part of large enterprises to prefer to complete one composite return. There were 54 such compenies in the 1965 survay. This procedure has the advantege to the employer of being able to complete one return at the central office end, for the survey teem, the advantege of a single return to process per company and no non-respondent problems. There are however great disadvantages raised by the difficulties of fitting such deta into an esteblishment-besed survey. Esteblishments with less than 500 employees would have more then one chance of being selected if they could not be identified and removed from the freme before the sample was drawn. If such establishments were withdrawn from the sampling frame, thare would be further problems of adjustment to the control data and even greater problems at the estimeting stage.

16.9 Since it wes deemed preferable to eim at esteblishment returns throughout, all those firms who mede a composite return in 1965 were approached in September 1967 to see whether they would be prepared to complete establishment returns in January 1968. All but e few agreed to do so; the remeinder were most helpful in providing supplementary date to assist the estimating steges.

16.10 All such companies were sent questionnaires in advence of the main meiling date to give them greeter preperation time. This courtesy was also extended to other large estabiiahments as a forewerning of the impending survey and to give them greeter preparation time.

Sample in manufacturing

16.11 The semple frame of manufacturing establishments wes compiled by the Department of Employment and Productivity. The set included ell known establishments employing 100 or more persons and a one-in-four sample of those employing 11-99 persons. (The esteblishments relating to companies proposing to submit a composite raturn were withdrawn from the frame before the semple was drawn.)

16.12 The following procedures were applied. A starting point for each size range wes selected using random numbars, elphebetical order being taken as

* This was extended to include all establishments in the sampling frame which were located in Wales.

sufficiently approximeting to random order. Counting from the first establishmant selacted in this wey, thereafter each nth one was drawn, where 'n' was the invarse of the sempling fraction, until the end of the set. If the resulting sample wes less then five, the process was repeatad from the beginning until the eample reached thie size. Thue, wherever the set (i.a. total numbar in the freme) was equel to or lass then five, all establishmants were in the sample.

Sampla in construction

16.13 The list of eddresses to be epproached were drewn in a random manner by the Ministry of Public Building and Works from their depertmentel register.

Field stagee

16.14 The field stages were cerried out by the Oepartment of Employment and Productivity, under technicel control from the Ministry of Technology.

Scrutiny of returns

16.15 All questionnaires were scrutinized and the following points covered:

(a) Check tha identity of tha asteblishment as falling within the sample list.

(b) Chack for consistency in data and/or omiesione. So many of the early returns (75 par cent of the 1100 received by 13th January, 1968) had omissions in the vacancy end forecast columns that two types of standerd follow-up letters were devised.
Approximately 2000 were despatched relating to Tables 'A' and '8' covaring QSEs end 500 relating to Table '8' only.

(c) *Forecast.* If an establishment which made a return wes nevertheless unable or unwilling to maka a forecast, then an essumption of no change between 1968 and 1971 wes made and the date for 1968 plus vacancies wes repeated in the 1971 column.

(d) *QSEs working as technicians.* As in 1965, a pitfall was found in the first row of Table 'B' (for persons by type of work) where employers sometimes carried forward the total row of Table 'A' (for QSEs). As en editing rule this wes always queried on the ground that it was extremaly unlikely thet all QSEs employed in an establishment would be in technician posts.

(e) *Definition of technicians.* As in 1965, a considerable proportion of the telephone queries related to technicians and sought guidance on the inclusion of particular jobe or persons. In reply, amphasis was placed upon the need to concentrate on the neture of work performad and not on the qualificatione held by the persons in those jobs.

(f) *Other professional qualifications.* Ageln, as in 1965, many employers, feced with e choica of two places to record e man who held a 'professional' qualification, finding it ineppropriate to count him in aither Teble 'A' on quelification or Teble '8' on type of work made a plaa for en axtension of the qualification criteria for Table 'A'. The decision to refrain from extending these definitions in 1968 was explained by tha need to maintain comparability of deta end tha limitad resources available for the survey. All such cases were carefully considered by the Ministry of Technology and noted for any future surveys.

16.16 A nota was sent to local authorities esking for separate date on techniciens in schools. These date were not available from tha Oepartment of Educetion and Sciance end so were not fully covared in previous surveys. As response to the note in the originel covering letter wes disappointing, a special list was compiled of tha locel authorities which were likely to employ techniciens. 220 follow-up latters ware sent out and 160 returns receivad.

Response

16.17 In e year of many questionneires to industry, tha responsa was slower then usual and the fiald stages wera necessarily more protrected. The combined effort of the Regional Offices of both the Department of Employment end Productivity end the Ministry of Technology achiaved soma euccess in hastening slow respondents. Indeed it wes noted that reluctant employers were oftan able to complete the raturn in very short spaca of tima aftar personal contact had baan mede and a few points had been expleined.

Postel reminders

16.18 Only one postal remindar was sent out, in April 1968, when approximately 5600 letters were despetched. At this stage the returns received were about 40 per cent of tha total: it was not practicable to send out earlier raminders. As tha response rate rose comparatively slowly following the postal reminders, no furthar batches were sant. Instead attention was concentrated upon the planned personal approach using the regionel steff.

16.19 The Regional Offices were briefed by their respectiva Dapartments on the beckground to the survey and the points of difficulty likely to be encountered. Lists of addresses were elso sent to both officers simultaneously but the initiativa wes left with Regionel Offices of the Department of Empleymant and Productivity to ellocete the work-loed to their own locel employment exchanges or to call on the Regional Officer et the Ministry of Technology. The exception was in Scotlend for which the Ministry of Technology assumed complete responeibility. The first list covered the larger establishments. A check was made with the Regional Office to ensure that this round of telephona calls and/or visits was well under way before prepering the sacond set for

all non-respondents employing 200-499 persons. This was compiled in the first week in July and sent to the Regional Offices on 11 July 1968.

Reminders to particular establishments within selected MLHs

16.20 During August, by which time the Regional Officers had worked through the reminder lists sent them, a check was made on all outstanding establishments. Further efforts were made to hasten response using, where appropriate, departmental resources.

16.21 As will be seen from the tables on response, the overall response rate to the 1968 survey was 80·7 per cent. This is to be compared with 91 per cent in 1965. Approximately 170 employers in manufacturing and construction wrote refusing to complete the questionnaire: various reasons were offered for this.

Response by fields of employment

Table 49	Number of questionnaires despatched	Returns received	Refusals	Non-response	*Percentage response*
All fields	**10 967**	**8 647**	**201**	**1 919**	***80·7***
Manufacturing	7 761	6 138	160	1 463	*79·1*
Construction	613	380	15	216	*62·0*
Government departments	145	141	—	4	*97·2*
Research councils	10	8	—	2	*80·0*
Local authorities	1 669	1 589	6	74	*95·2*
Nationalized industries	36	35	—	1	*97·2*
Nationalized iron and steel	146	108	1	37	*74·0*
Industrial research associations	71	60	2	8	*84·5*
Independent research establishments	49	38	—	11	*77·6*
Private research laboratories	164	113	—	51	*68·9*
Management consultants	17	13	—	4	*76·5*
Engineering consultants	285	224	17	45	*78·3*

Source: Department of Employment and Productivity

Response by size range of total employees

Table 50	Number of establishments in sample	Returns received	Refusals	Non-response	*Percentage response*
MANUFACTURING					
All establishments	**7 761**	**6 138**	**160**	**1 463**	***79·1***
11- 49 employees	746	587	5	156	*78·5*
50- 99 „	1 138	871	6	260	*76·7*
100-199 „	803	612	6	185	*76·2*
200-499 „	2 428	1 902	56	470	*78·3*
500 and over	2 648	2 166	88	392	*81·9*
CONSTRUCTION					
All firms	**613**	**380**	**16**	**216**	***62·0***
35- 59 employees	43	34	—	9	*79·1*
60- 79 „	39	27	—	12	*69·2*
80-114 „	54	37	—	17	*68·5*
115-299 „	129	88	3	40	*66·7*
300-599 „	145	94	2	49	*64·8*
600-1 199 „	125	64	5	57	*50·8*
1 200 and over	77	38	5	34	*49·4*

Source: Department of Employment and Productivity

Processing steges

Punch cards

16.22 Deta from returns wera transferred to punch cards as soon as scrutiny and follow-ups were complete. One card was punched for every line on the questionnaire in which data were given. The identification dete, i.e. codes representing region, MLH, industry group, size group, were punched into all cerds. This formet wes the most economicel for the straight processing of deta, meking the best use of the machine processing facilities available at the Department of Employment and Productivity, Watford. However, es explained under 'calculation of sampling errors' below, the process of transfer to magnetic tape for a computer involved considerable detailed work.

16.23 Summaries of respondent dete were prepared by the tabulator for eech MLH or industry group and size range for each line of the questionnaire. This wes done once only, initially for Great Britain, it being estimated that the most economical way of obtaining data for Scotland and Walee separetely would be to defer this until the magnetic tape was aveilable.

Control data for manufecturing

16.24 The data of total employment by industry group and size renge were calculeted using the employment returns for 13 January 1968. The complete sat of returns at the end of March 1968 was assembled and processed. Between that date and October 1968, when the astimating stage began, careful note wes mede of additional late receipts and the data of totel employment for the corresponding cells amended accordingly.

Adjustment for composite returns

16.25 Apart from those companies who had been uneble to accept the request to submit establishment rether than enterprise returns, thera were other returns which on examination were shown to be covering more than one establishment. Special arrangements were made therefore to adjust the control data for these ovarleps before the estimating procedures wera carried out.

17 Data from the survey

17.1 Some of the more interesting enalyses of the date from the survey ere given in the twenty-seven tables, S1 to S27. The corresponding date from the 1965 and 1962 surveys are also included for comparison. These dete should be used in conjunction with the 'Notes on Survey Tables' and the text in Section 20 of tha Appendix and with regard to the following paragraphs.

Stetisticel precision

17.2 Establishments employing fawer than 500 persons, covering ebout 30 per cent of all QSEs, were covered by a sample enquiry. The sampling frame evailable is stretified by SIC heedings and by size, measured by the total number of persons employed at the establishment. The pattern of employment of OSEs is dependent elso on additional fectors, such as reletive advances in technology and the research intensity of individuel establishmente. This means thet there is considereble variation, even within streta. It is to be expected, therefore, that the measurable veriances based on the semple data will vary from industry to industry end from survey to survey.

17.3 In Table 51, the stendard errors are quoted. Three industry groups in particuler heve shown lerge increases in percentege standard error ovar the three yeers, probably due to the edvances in technology and research intensity, mentioned in the previous peregraph. It is interesting to note that the inter-industry diffarences due to technological chenges are anticipated in the 1968 ravision of the Stenderd Industrial Classificetion. In the revision, electronic computers are given a separate Minimum List Head-

Manufacturing

Standard errors

Table 51

	1966		1968	
	Number of QSEs	*Percentage standard error*	Number of QSEs	*Percentage standard error*
All menufecturing	**98 540**	***1·2***	**111 276**	***1·8***
Food, drink, tobacco	4 584	*5·4*	5 114	*4·0*
Chemicals end allied industries (excluding mineral oil refining)	17 415	*2·3*	19 920	*2·9*
Mineral oil refining	2 492	—	2 524	*0·8*
Metel manufecture	7 213	*3·7*	7 547	*4·0*
Mechenicel engineering	21 278	*2·9*	23 335	*3·4*
Electrical engineering	9 214	*4·0*	8 547	*4·3*
Electronics	11 834	*4·3*	16 375	*8·9*
Aircraft	6 886	*1·8*	7 183	*7·0*
Motor vehicles	2 811	*3·2*	2 995	*7·4*
Textiles, clothing, etc.	5 156	*4·1*	5 979	*5·5*
Other manufacturing	7 707	*5·8*	9 028	*4·3*

Source: Ministry of Technology

ing and any recalculation of the 1968 survay data on this new besis would tend to smooth out these high variances. Until resources are availeble for this lengthy operation, the 1968 survey data must be ratained in the existing form, releted to the 1958 SIC, but work is being undertaken to isolata end reweight for the most disturbing elements.

17.4 The standerd errors are given in Table 51 and compared with those of the 1965 survey. Standard errors are given in percentege terms and may ba interpreted es indicating that the true value has a 95 per cent chance of lying within an interval of two stendard errors about the estimate. The calculation of the standard error is besed upon the following expression:

$$V(\hat{Y}_R) = \frac{N(N-n)}{n(n-1)} \left(\Sigma y_i^2 + \hat{R}^2 \Sigma x_i^2 - 2\hat{R} \Sigma y_i x_i \right)$$

where N is the number of establishmants in the field
n is the number of esteblishments in the sampla
y_i is the number of QSEs in esteblishment i
x_i is the number of employees in esteblishmant i

$$\hat{R} = \Sigma y_i / \Sigma x_i$$

17.5 Two further points of interest should be mentioned:

(a) The sampla for elactronics includes establishments representing advanced points in the technological spectrum. This was reflected in amployment of QSEs: an exampla ie advanced computer techniques. It cannot be stated for certain, that the establishments observed are representative of the whole 'group within a group' or are corractly weighted within the original group. Therefore no attempt has been made to re-estimate taking this factor into account.

(b) Although it has always been known that reseerch establishments were present in the sampling frame for manufecturing, 1968 eppeers to be the first time that thay heve had any substantial effect on verlences. As in (a) ebove these esteblishmants are essentially a part of the industry group as constituted under the SIC 1958 revised end as such must be left in the semple. However, it is of interest to note that, subject to the availability of separate economic data, the SIC 1968 revised will code these to a separate rate MLH 876, Research and development services.

17.6 A further point which ehould be mentioned at this stage is that the decision, for the 1968 survay, to persuade larger companies to provide esteblishment-based rather than composite returns has inevitably increeeed the veriances. There is e bies towards QSEs in research intensive establishments in those companies the effect of which has been minimised in the methods of eggragation. This fector should be borne in mind when planning future surveys.

Grossing-up respondent data

17.7 The data given in the tables are derived from the respondent deta, assuming sector by sector that the respondents were representative of ell employers. Where reliable dete on total employment were available, the ratio between this end employment data from the returns wes used for grossing-up; the formula being $\hat{Y} = y \frac{X}{x}$ where y wes the total QSEs from the returns, x was the total employment from the returns and X was the total employment in all esteblishments and firms in the population. This procedure was used for menufacturing. In sectors where reliable data on total employment in the population are not availeble, the alternetive formula $\hat{Y} = y \frac{N}{n}$ was used; where n wes the number of establishments in the semple and N the number of establishments in the population. Although data on total employment hed been provided by the Ministry of Public Building and Works for the construction industry, et the estimeting stage it wes decided to use the alternative formule for $\hat{Y}$. This gives data for the 1968 survey celculated on tha same basis as the deta for 1965. This decision was based upon the examination of the variations in total employment data per firm between the date of the sampling frame end the date of the survey. Part of the difference could have been eliminated with e seasonal adjustment but the residual difference appeared to be too greet to be ignored.

Non-response errors

17.8 Since there were no dete available to show how non-respondents might differ from respondents in the particular charactaristic which was being surveyed, i.e. employment of qualified manpower, the simple solution in estimating was to assume that both groups of establishments were represented by tha respondants. Consideration of the nature of the characteristic auggests that the assumption may be less true for smaller establishments; the chance inclusion of one establishment of high QSE density hes a considarable influence on the estimates in these size ranges.

Response errors

17.9 It is known that tha exposure to repeated survays has mede employers more ewere of the qualifications held by persons in their employment and that this development has had some effect on

the data collected. This is very difficult to quantify. Some of the revisions heve been upward, as employers improved their knowledge of qualifications elreedy held by existing amployees, either by more sophisticated methods of keeping personnel records or merely by being more willing to spend time in collating deta for the retum. A few of the revisions will have been downward, es the employer becomas more precise as, for example, by counting persons with degrees in physica rather than in assuming that all graduate-level staff in the physics leboratory have dagrees in phyaica.

17.10 Another similer possible source of arror is variable interpratation of the seme definition from survey to survey. It is seldom that the same person within an esteblishment is responsible for two consecutive surveys. Unless there are records which are pre-coded to a standardized classification system there is always the possibility of error in aggregetad returns. A safaty check on the more outstanding incidance of such errore could have been provided by a matching operation but this was beyond the resources available to this survey.

Employers' estimates of requirements

17.11 It is important to beer in mind the neture of the data given in column 7 of the questionnaire, in which the employer was asked to estimate '*The number of persons you aim to heve in your employment at 1st Jenuary 1971*'. In the notes he wes asked to assume that the requirad persone are aveileble and that, '*You will have no vacancies at thet date, i.e. that you will have filled your present vacancies end also any other vacancies that may have arisen between 1st January 1968 and 1st January 1971*'.

Future requirements

17.12 More end mora companies ere adopting eystems of planning which encompass manpower and other resources but others, less well-equipped, mey face a very difficult task. Frequently there will ba very inadequata deta on which to baae e forecast three years ehead. Evan with sufficient data readily aveileble the calculation of the job content implicit in a company'a forwerd planning and the astimation of the work force needed to implement it, is an extremely complex process. Moreovar, tha employer can only hazard a guess at the trenda in tha general economic situetion and Government policy in meeting those trends. Inevitebly in such circumstances soma employers may be reluctant, or unwilling, to make en estimate for a aurvey return. For those establishments unable to meke a forward estimate the data for 1968 plus the numbar of vecancies are cerriad forward to 1971; the raturns in question account for only 2 per cent of the QSEs employed by the sectors covered by the survey.

17.13 Two other aspects should be borne in mind when considering theee deta on forecasts. Ona is the possibility that, even using the best data available at the time of making his forward estimates, an employer can still be proved wrong by event. Forces outside his control, perticulerly major decisions affecting the growth of the economy, ere also frequently unpradictable. The other is that, although little is known about the structura of industrial growth and reason for differing rates of change, it can be stated with certainty thet the seperate estimates of the component companias of an industry group will not always ba additiva. In e highly competitiva situetion, two, three or more companias mey be basing their forward estimates on the essumption that they will each win the lion's share of e particuler market. Thia could lead to an overstatement for the industry as a whole. No allowance for these factors has bean mada in aggregating employers' estimates of future requirements given in the 'forecast' column of the tables. These factors should be taken into account when using the results of aggragating both employers' current returns of QSEs, end employars' estimates of future raquirements which, for convenience, are given in the Survey tablas side by side.

17.14 If one is intereeted in obteining some measure of the extent to which employers' anticipations excead or fall below their recruitmant performance, then a more appropriete match might be given by taking 'current employment plus vacancies' ae being comperabla to the 'estimated requiremente three years hence' made in the previous survey. It will ba notad that the question to employers specificelly esks them to assuma that all vecancies are filled. Thus current employment plus vecancies might be termed 'effective demand' to be compared with 'predicted requirements' or 'foracest futura demand'. The chart with its accompanying table shows the results of this operation. A further 'alternativa forecast' for 1971 is calculated, assuming thet the percentege rate of increase from 1965 to 1968 also applies to 1968 to 1971. Thie ie also shown in the chart.

Electronics

17.15 It is interesting to note that while manufacturing es a whole tends to overestimete its requirements for QSEs, en expanding industry such as electronics runs contrary to this pattern. This feature is illustratad below. While the estimeted number of QSEs actually employed in 1968, 16 375, is slightly below the forecast made in 1965, 16 588, the effective demand, i.e. the numbers employed plue the numbers of vacancies, is considerably greater.

QSEs in electronics in 1968

	All QSEs	*Engineering and technology*	*Science*
As estimated in 1965[7]	16 588	11 480	5 108
Actual employment (Table S6)	18 375	10 887	5 508
Vacancies	1 757	1 212	545

The nationalized industries and public corporetions show a similar pattern.

Comparison of forecasts with effective demand (employment plus vacancies)

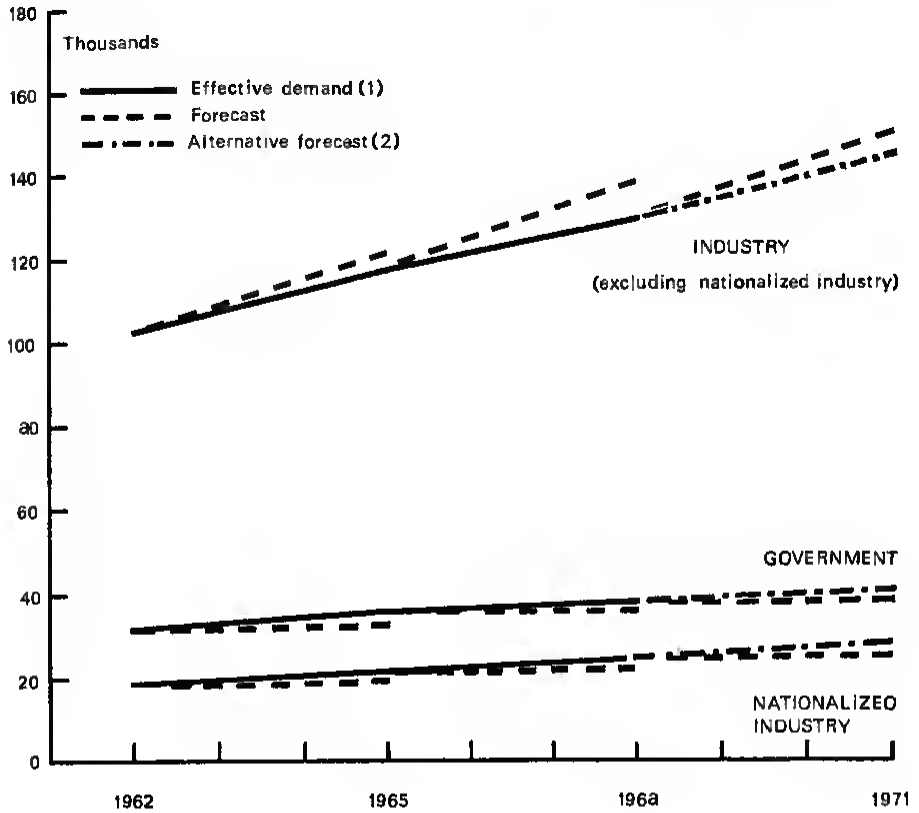


Table 52		Industry		Nationalized industry		Government	
		Number in survey (Thousands)	*Per cent increase*	Number in survey (Thousands)	*Per cent increase*	Number in survey (Thousands)	*Per cent increase*
1962	Effective demand[1]	103·4		17·5		30·5	
1966	Forecast	120·2	*16·3*	19·2	*9·7*	32·2	*5·4*
	Effective demand	118·1	*14·2*	20·2	*15·5*	35·1	*15·1*
1968	Forecast	137·9	*16·8*	22·7	*12·7*	36·5	*4·0*
	Effective demand	130·6	*10·6*	23·7	*17·6*	37·3	*6·3*
1971	Forecast	149·5	*14·5*	24·5	*3·4*	38·5	*3·2*
	Alternative forecast[2]	144·4	*10·6*	27·9	*17·6*	39·7	*6·3*

(1) Effective demand is defined as current employment plus vacancies

(2) Alternative forecast assuming same percentage increase from 1968 to 1971 as from 1965 to 1968.

17.16 However, too much attention should not be paid to the absolute differences between actual employment and estimates. It is of interest that, over the period of years covered by this study, the *relative* scarcities and potential surpluses of persons qualified in certain subjects have been clearly identified from the data supplied by employers.

Vacancies

17.17 There are difficulties in defining a vacancy in such a way that consistency of interpretation is assured. For these surveys a vacancy is defined as: 'a post which you are actively seeking to fill by the recruitment of a person holding a qualification in engineering, technology, or science'.

17.18 The extent of substitution raises special problems. Employers understandably find difficulty in being specific about the exact academic background required when two or more qualifications ere equally suitable as in non-technical posts. In such cases, where more than one qualification would be equally acceptable, employers were asked to give the preferred qualification. (This problem is less acute in making forward estimates since it is easier to anticipate the 'mix' of disciplines in the whole labour force than to identify the precise subject of qualification of those about to be recruited.) Again the 'chain reaction' of one internal transfer may induce other transfers and it may be difficult to predict which post will actually be filled by recruitment from outside the organization.

17.19 it has been observed in American surveys that there is a high correlation between data on vacancies and data on forecasts given by employers. This is perhaps not surprising. The two could be regarded as reflecting current and short-term recruitment plans respectively, in which case one would expect there to be a positive connection between the two. In practice, statistics of vacancies provide a sensitive indicetor of chenges in industrial demand for QSEs (see Tables S4 and S8).

The survey tables

Persons holding degree or equivalent qualifications in engineering, technology and science

Persons working as technicians or technical supporting staff

Symbols used

The following symbols have been used throughout the tables:

.. not available

— nil or negligible

Notes on survey tables

18.1 Data from Tables S1 to S27 should be used in conjunction with the following notes.

Forecast 1971

18.2 These columns give the results of aggregating employers' estimated requirements three years ahead (see also paragraphs 17.11 and 17.12).

Manufacturing

18.3 The definitions of the twelve groups of manufacturing are given below in terms of the SIC, 1958 revised.

	SIC revised 1958	
	Order	MLH
Food, drink and tobacco	III	211-240
Chemicals and allied industries (excluding mineral oil refining)	IV	261, 263-277
Mineral oil refining	IV	262
Metal manufacture	V	311-322
Mechanical engineering	VI and IX	331-339, 341, 342, 349, 351, 352, 391-399
Electrical engineering	VI	381, 362, 365, 369
Electronics	VI	363, 364
Aircraft	VIII	383
Motor vehicles	VIII	381, 382, 389
Other vehicles	VII and VIII	370, 384, 385
Textiles, clothing, etc.	X, XI and XII	411-429 431-433 441-450
Other manufacturing	XIII XIV XV XVI	461-469 471-479 481-489 491-499

18.4 Data for manufacturing in all tables covers all privately-owned establishments employing 11 or more persons and does not include establishments owned by nationalized industries, public corporations and the Atomic Energy Authority. The latter establishments are shown under the appropriate employer heading which is the basis of classification of all data from these surveys. (See also 18·6)

18.5 No separate data on a comparable basis ara available from the 1962 survey for electronics and elactrical anginaering. A combinad total is tharefore givan for comparative purposes.

18.6 Tha industry group, matal manufactura, includes British Steel Corporation in addition to private stael companias in tha 1968 and 1971 data. Thase hava been included to maintain comparability with tha previous surveys.

Other fields of employment

18.7 Data from the 1968 survey are compared in the tables published in Cmnd. 3103. Thare are certain points at which these data do not give an accurate estimate of change:

(a) *Industrial research associations.* It appears that tha data for 1965 includa the Rutherford High Energy Laboratory which was at that tima part of the National Institute for Resaarch in Nuclear Sciencas. In 1968 it was part of Science Research Council and therefore appaars under the heading 'Resaarch councils'.

(b) *Research councils.* In 1965 this haading contained Agricultural Research Council and Medical Research Council. In 1968 the heading includes, in addition, National Environmental Rasearch Council, Scienca Research Council and Social Science Research Council. At January 1965, the majority of the establishments ware undar the Department of Scientific and Industrial Research and therefore included under Central Government. (Nota (a) covars one of the exceptions.)

(c) *Government departments.* Due to reorganization these also represent a slightly different coveraga in 1968 compared with 1965. Tha Forestry Commission and Metropolitan Police were included in 1965 but were not covered in 1968. Of the 15 000 QSEs in Govarnment departmants, about one-third were in departmants which wara not able to provida a forecast for 1971. An arbitrary estimata was tharafore made, bearing in mind the generally accepted developments in the departments concerned. For this reason the forecast figures for Government departments should be regarded as approximate.

(d) *Nationalized industries.* This group has also been subject to reorganization batwaen 1965 and 1968. Airway corporations now include British Airports Authority transferred from Ministry of Aviation; British Transport has also baen reconstituted.

(e) *Armed Forces.* QSEs within the Armed Forces are included in the Summary Table S1 only. Comparable astimates by datailed subject of qualification are not available.

(f) *Technicians in schools.* The incraase suggested by a comparison of the data from tha 1965 and 1968 survays is possibly overstated. In 1965 soma local authorities wera unable to provida this information.

(g) *Technician's certificate.* In the 1968 survey the definition is amendad to exclude any 'similarly recognisad qualification'. These qualifications are shown on line 25 of tha 1968 questionnaire on p.115. (See Tables S16 and S20).

Persons holding degree or equivalent qualifications in engineering, technology and science

SUMMARY TABLE

1965, 1968 and forecast 1971

Table S1	All subjects	Engineering	Technology	Science
1965				
FIELDS OF EMPLOYMENT IN THE SURVEY				
Total*	**211 278**	**108 255**	**12 703**	**90 320**
Industry	107 960	64 472	10 524	32 964
Nationalized industry	19 180	17 333	211	1 636
Government	32 383	19 682	737	11 964
Education	51 756	8 768	1 231	43 756
Armed Forces	4 617	3 451	20	1 048
1968				
FIELDS OF EMPLOYMENT IN THE SURVEY				
Total*	**240 134**	**123 593**	**13 869**	**102 672**
Industry	123 121	73 773	11 282	38 066
Nationalized industry	22 385	19 451	359	2 675
Government	34 321	21 140	728	12 453
Education	60 307	9 229	1 500	49 578
Armed Forces	4 724	3 560	59	1 105
Forecast 1971				
FIELDS OF EMPLOYMENT IN SURVEY				
Total	**276 905**	**147 418**	**16 232**	**115 255**
Industry	149 508	91 214	13 624	44 770
Nationalized Industry	24 539	21 416	374	2 749
Government	38 507	24 419	667	13 421
Education	66 351	10 389	1 667	54 315

*Excluding the Armed Forces.

Persons holding degree or equivelent quelifications in engineering, technology and science

ALL FIELDS OF EMPLOYMENT IN SURVEY

Analysis by research and development and other functions, 1962, 1965, 1968 and forecast 1971

Table S2

	All subjects					Engineering					Technology					Science				
	All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions	
				R & D	Other				R & D	Other				R & D	Other				R & D	Other
ALL FIELDS OF EMPLOYMENT IN SURVEY																				
1962	183 240	..	..	..	..	..	..	..	..	..	..	..	..	..	..	75 458	..	..	..	..
1965	211 278	..	..	..	..	108 255	..	..	..	..	12 703	..	..	..	..	90 320	..	..	..	..
1968	240 134	..	..	..	..	123 593	..	..	..	..	13 869	..	..	..	..	102 672	..	..	..	..
1971	278 905					147 418					16 232					115 256				
INDUSTRY																				
Menufecturing																				
1962	86 221	31 837	54 384	36·9	63·1	51 498	14 769	36 729	28·7	71·3	8 946	2 878	6 068	32·2	67·8	26 777	14 190	11 587	55·0	45·0
1965	98 540	37 124	61 416	37·7	62·3	66 947	17 795	39 152	31·2	68·8	10 100	3 055	7 045	30·2	69·8	31 493	16 274	15 219	51·7	48·3
1968	111 278	38 914	72 382	35·0	65·0	64 395	17 811	46 584	27·7	72·3	10 286	2 836	7 450	27·6	72·4	36 595	18 267	18 328	49·9	50·1
1971	134 558					79 119					12 313					43 126				
Construction																				
1962	6 291	456	5 835	7·2	92·8	5 879	431	5 448	7·3	92·7	238	—	238	—	100·0	174	25	149	14·4	85·6
1965	7 190	281	6 909	3·9	96·1	8 928	253	6 676	3·7	96·3	89	—	89	—	100·0	173	28	145	16·2	83·8
1968	9 670	417	9 253	4·3	95·7	8 630	288	8 362	3·1	96·9	682	41	641	6·0	94·0	358	108	250	30·2	69·8
1971	12 399					11 167					843					389				
Industriel research essocietions [1]																				
1962	1 880	1 800	80	95·7	4·3	490	458	32	93·5	6·5	301	296	5	98·3	1·7	1 089	1 046	43	96·1	3·9
1965	2 230	2 003	227	89·8	10·2	597	466	131	78·1	21·9	335	317	18	94·6	5·4	1 298	1 220	78	94·0	6·0
1968	2 175	1 973	202	90·7	9·3	748	636	112	85·0	15·0	314	283	31	90·1	9 9	1 113	1 054	59	94·7	5·3
1971	2 551					928					368					1 255				
NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS																				
1962	18 382	2 153	14 229	13·1	86·9	15 078	1 355	13 723	9·0	91·0	161	62	99	38·5	61·5	1 143	738	407	64·4	35·6
1965	19 180	2 381	16 799	12·4	87·6	17 333	1 308	16 025	7·5	92·5	211	151	60	71·6	28·4	1 636	922	714	56·4	43·6
1968	22 385	2 750	19 635	12·3	87·7	19 451	1 587	17 864	8·2	91·8	359	179	180	49·9	50·1	2 575	984	1 591	38·2	61·8
1971	24 539					21 416					374					2 749				
GÖVERNMENT																				
Totel																				
1982	28 254	..	..	..	..	17 225	..	..	..	..	710	..	..	..	..	10 319	..	..	..	..
1965	32 383	12 080	20 303	37·3	62·7	19 682	4 204	15 478	21·4	78·6	737	429	308	58·2	41·8	11 964	7 447	4 617	62·2	37·8
1968	34 321	12 517	21 804	36·5	63·5	21 140	4 308	16 832	20·4	79·6	728	397	331	54·5	45·5	12 453	7 812	4 641	62·7	37·3
1971	38 507					24 419					667					13 421				

Table S2
(continued)

	All subjects					Engineering					Technology					Science				
	All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions	
				R & D	Other				R & D	Other				R & D	Other				R & D	Other
Government departments[1]																				
1962	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1965	15 946	6 917	9 029	*43·4*	*56·6*	8 313	2 855	5 458	*34·3*	*65·7*	306	167	139	*54·6*	*45·4*	7 327	3 895	3 432	*53·2*	*46·8*
1968	14 972	6 345	8 627	*42·4*	*57·6*	7 877	2 783	5 094	*35·3*	*64·7*	305	165	140	*54·1*	*45·9*	6 790	3 397	3 393	*50·0*	*50·0*
1971	15 484					8 080					275					7 129				
Research councils[1]																				
1962	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1965	1 756	1 747	9	*99·5*	*0·5*	63	53	—	*100·0*	—	2	2	—	*100·0*	—	1 701	1 692	9	*99·5*	*0·5*
1968	2 939	2 750	189	*93·6*	*6·4*	271	162	109	*59·8*	*40·2*	5	3	2	*60·0*	*40·0*	2 883	2 585	78	*97·1*	*2·9*
1971	3 627					309					5					3 313				
Atomic Energy Authority																				
1962	5 302	3 601	1 701	*67·9*	*32·1*	2 543	1 471	1 072	*57·8*	*42·2*	333	278	55	*83·5*	*16·5*	2 426	1 852	574	*76·3*	*23·7*
1965	5 031	3 168	1 863	*63·0*	*37·0*	2 481	1 132	1 349	*45·6*	*54·4*	309	258	53	*82·8*	*17·2*	2 241	1 780	461	*79·4*	*20·6*
1968	4 685	3 037	1 648	*64·8*	*35·2*	2 270	1 115	1 156	*49·1*	*50·9*	272	226	44	*83·8*	*16·2*	2 143	1 694	449	*79·0*	*21·0*
1971	4 448					2 168					263					2 027				
Local authorities[2]																				
1962	7 913	..	..	..	..	7 490	..	..	..	..	88	..	..	..	..	365	..	..	..	..
1965	9 650	248	9 402	*2·6*	*97·4*	8 835	164	8 671	*1·9*	*98·1*	120	4	116	*3·3*	*96·7*	695	80	615	*11·5*	*88·5*
1968	11 725	385	11 340	*3·3*	*96·7*	10 722	248	10 474	*2·3*	*97·7*	146	1	145	*0·7*	*99·3*	857	136	721	*15·9*	*84·1*
1971	14 948					13 862					134					952				
EDUCATION																				
Total																				
1962	44 212	..	..	..	..	..	..	..	..	..	..	..	..	..	..	36 956	..	..	..	..
1965	51 755	..	..	..	..	6 768	..	..	..	..	1 231	..	..	..	..	43 756	..	..	..	..
1968	60 307	..	..	..	..	9 229	..	..	..	..	1 500	..	..	..	..	49 678	..	..	..	..
1971	66 351					10 369					1 667					64 315				
Universities[2]																				
1962	8 114	..	..	..	..	1 399	..	..	..	..	271	..	..	..	..	6 444	..	..	..	..
1965	13 885	..	..	..	..	2 719	..	..	..	..	461	..	..	..	..	10 706	..	..	..	..
1968	18 872	..	..	..	..	3 368	..	..	..	..	591	..	..	..	..	14 713	..	..	..	..
1971	21 355					3 868					681					16 806				
Schools and further education establishments																				
1962	36 098	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30 612	..	..	..	..
1965	37 870	..	..	..	..	4 049	..	..	..	..	770	..	..	..	..	33 051	..	..	..	..
1968	41 835	..	..	..	..	6 861	..	..	..	..	909	..	..	..	..	34 865	..	..	..	..
1971	44 996					6 501					986					37 609				

(1) Data for 1965 are not strictly comparable with 1968. See general notes.
(2) Data for 1965 include colleges of advanced technology

Persons holding degree or equivalent qualifications in engineering, technology and science

ALL FIELDS OF EMPLOYMENT IN SURVEY

Change in numbers employed between 1962 and 1965, 1965 and 1968, and forecast 1968 to 1971

Table S3

	1962 to 1965			1965 to 1968			Forecast 1968 to 1971		
	Number in 1962	Change between 1962 and 1965	*Change as a per cent of 1962*	Number in 1965	Change between 1965 and 1968	*Change as a per cent of 1965*	Number in 1968	Forecast change between 1968 and 1971	*Change as a per cent of 1968*
ALL FIELDS OF EMPLOYMENT IN SURVEY									
All subjects	183 240	28 038	*15·3*	211 278	28 856	*13·7*	240 134	38 771	*16·1*
Engineering	107 782	13 178	*12·2*	108 255	15 338	*14·2*	123 593	23 825	*19·3*
Technology				12 703	1 166	*9·2*	13 869	2 363	*17·0*
Science	75 458	14 862	*19·7*	90 320	12 352	*13·7*	102 672	12 583	*12·3*
INDUSTRY									
Manufacturing									
All subjects	86 221	12 319	*14·3*	98 540	12 736	*12·9*	111 276	23 282	*20·9*
Engineering	61 498	5 449	*10·6*	56 947	7 448	*13·1*	64 395	14 724	*22·9*
Technology	8 946	1 154	*12·9*	10 100	186	*18·4*	10 286	2 027	*19·7*
Science	25 777	5 718	*22·2*	31 493	5 102	*16·2*	36 595	6 531	*17·8*
Construction									
All subjects	8 291	899	*14·3*	7 190	2 480	*34·5*	9 870	2 729	*28·2*
Engineering	5 879	1 049	*17·8*	6 928	1 702	*24·6*	8 630	2 537	*29·4*
Technology	238	—149	*—62·6*	89	593	*666·3*	682	161	*23·6*
Science	174	— 1	*— 0·6*	173	185	*106·9*	358	31	*8·7*
Industriel reseerch essociations [1]									
All subjects	1 880	350	*18·6*	2 230	— 55	*— 2·5*	2 176	376	*17·3*
Engineering	490	107	*21·8*	597	151	*25·3*	748	180	*24·1*
Technology	301	34	*11·3*	335	— 21	*— 6·3*	314	54	*17·2*
Science	1 089	209	*19·2*	1 298	—185	*—14·3*	1 113	142	*12·8*
NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS									
All subjects	16 382	2 798	*17·1*	19 180	3 205	*16·7*	22 385	2 164	*9·6*
Engineering	15 078	2 255	*15·0*	17 333	2 118	*12·2*	19 451	1 965	*10·1*
Technology	161	50	*31·1*	211	148	*70·1*	359	15	*4·2*
Science	1 143	493	*43·1*	1 638	939	*57·4*	2 575	174	*6·8*
GOVERNMENT									
Total									
All subjects	28 254	4 129	*14·6*	32 383	1 938	*6·0*	34 321	4 186	*12·2*
Engineering	17 225	2 457	*14·3*	19 682	1 458	*7·4*	21 140	3 279	*15·5*
Technology	710	27	*3·8*	737	—9	*—1·2*	728	—61	*—8·4*
Science	10 319	1 645	*15·9*	11 964	489	*4·1*	12 453	968	*7·8*

Table S3 (continued)

	1962 to 1965			1965 to 1968			Forecast 1968 to 1971		
	Number in 1962	Change between 1962 and 1965	*Change as a per cent of 1962*	Number in 1966	Change between 1965 and 1968	*Change as a per cent of 1965*	Number in 1968	Forecast change between 1968 and 1971	*Change as a per cent of 1968*
Government departments[1]									
All subjects	..	..	..	15 946	—974	*—6·1*	14 972	512	*3·4*
Engineering	..	..	..	8 313	—436	*—5·2*	7 877	203	*2·6*
Technology	..	..	..	306	—1	*—0·3*	305	—30	*—9·8*
Science	..	..	..	7 327	—537	*—7·3*	6 780	339	*5·0*
Research councils[1]									
All subjects	..	..	..	1 756	1 183	*67·4*	2 939	688	*23·4*
Engineering	..	..	..	53	218	*411·3*	271	38	*14·0*
Technology	..	..	..	2	3	*150·0*	5	—	—
Science	..	..	..	1 701	962	*56·6*	2 663	650	*24·4*
Atomic Energy Authority									
All subjects	5 302	—271	*—5·1*	5 031	—346	*— 6·9*	4 685	—237	*—5·1*
Engineering	2 543	— 62	*—2·4*	2 481	—211	*— 8·5*	2 270	—102	*—4·5*
Technology	333	— 24	*—7·2*	309	— 37	*—12·0*	272	— 19	*—7·0*
Science	2 426	—185	*—7·6*	2 241	— 98	*— 4·4*	2 143	—116	*—5·4*
Local authorities									
All subjects	7 913	1 737	*22·0*	9 650	2 076	*21·5*	11 726	3 223	*27·5*
Engineering	7 490	1 345	*18·0*	8 835	1 887	*21·4*	10 722	3 140	*29·3*
Technology	68	52	*76·5*	120	26	*21·7*	146	—12	*—8·2*
Science	355	340	*95·8*	695	162	*23·3*	867	95	*11·1*
EDUCATION									
Total									
All subjects	44 212	7 543	*17·1*	51 755	8 552	*16·5*	60 307	6 044	*10·0*
Engineering	7 258	743	*10·2*	6 768	2 461	*36·4*	9 229	1 140	*12·4*
Technology				1 231	269	*21·9*	1 500	167	*11·1*
Science	36 956	6 800	*18·4*	43 758	5 822	*13·3*	49 578	4 737	*9·6*
Universities[2]									
All subjects	8 114	5 771	*71·1*	13 885	4 787	*34·5*	18 672	2 683	*14·4*
Engineering	1 399	1 320	*94·4*	2 719	648	*23·9*	3 368	500	*14·8*
Technology	271	190	*70·1*	461	130	*28·2*	591	90	*15·2*
Science	6 444	4 261	*66·1*	10 705	4 008	*37·4*	14 713	2 093	*14·2*
Schools end further education esteblishments									
All subjects	36 098	1 772	*4·9*	37 870	3 785	*9·9*	41 635	3 361	*8·1*
Engineering	5 686	—767	*—13·7*	4049	1 812	*44·8*	5 861	640	*10·9*
Technology				770	139	*18·1*	909	77	*8·5*
Science	30 512	2 639	*8·3*	33 051	1 814	*5·5*	34 865	2 644	*7·6*

(1) Data for 1965 are not strictly comparable with 1968. See general notes.
(2) Data for 1965 include colleges of advanced technology.

Persons holding degree or equivelent quelifications in engineering, technology end science

ALL FIELDS OF EMPLOYMENT IN SURVEY

Vecancies reported by employers et January 1965 and January 1968

Table S4

	1965			1968		
	QSEs employed	Vecancies	*Vecancies es a per cent of QSEs employed*	QSEs employed	Vecancies	*Vecancies es a per cent of QSEs employed*
ALL FIELDS OF EMPLOYMENT IN SURVEY (excluding schools and further education establishments)						
All subjects	173 408	14 609	*8·4*	198 499	12 483	*6·3*
Engineering	104 206	9 963	*9·6*	117 732	8 205	*7·0*
Technology	11 933	755	*6·3*	12 960	589	*4·5*
Science	57 269	3 891	*6·8*	67 807	3 689	*5·4*
INDUSTRY						
Menufecturing						
All subjects	98 540	9 067	*9·2*	111 278	6 928	*6·2*
Engineering	56 947	6 941	*10·4*	64 395	4 244	*6·6*
Technology	10 100	613	*6·1*	10 286	526	*5·1*
Science	31 493	2 513	*8·0*	36 596	2 158	*5·9*
Construction						
All subjects	7 190	811	*11·3*	9 670	421	*4·4*
Engineering	6 928	765	*11·0*	8 630	412	*4·8*
Technology	89	27	*30·3*	682	6	*0·9*
Science	173	19	*11·0*	358	3	*0·8*
Industriel reseerch essocietione						
All subjects	2 230	224	*10·0*	2 175	121	*5·6*
Engineering	597	55	*9·2*	748	53	*7·1*
Technology	335	34	*10·1*	314	13	*4·1*
Science	1 298	135	*10·4*	1 113	55	*4·9*
NATIONALIZED INDUSTRIES ANO PUBLIC CORPORATIONS						
All subjects	19 180	995	*5·2*	22 385	1 336	*6·0*
Engineering	17 333	913	*5·3*	19 451	1 149	*5·9*
Technology	211	1	*0·5*	359	15	*4·2*
Science	1 636	81	*5·0*	2 575	172	*6·7*
GOVERNMENT						
Totel						
All subjects	32 383	2 732	*8·4*	34 321	3 006	*8·8*
Engineering	19 682	2 060	*10·5*	21 140	2 195	*10·4*
Technology	737	42	*5·7*	728	6	*0·8*
Science	11 964	630	*5·3*	12 453	805	*6·5*

Table S4 (continued)

	1965			1968		
	QSEs employed	Vacancies	*Vacancies as per cent of QSEs employed*	QSEs employed	Vacancies	*Vacancies as a per cent of QSEs employed*
Government departments[1]						
All subjects	15 948	799	*5·0*	14 972	784	*5·1*
Engineering	8 313	430	*5·2*	7 877	304	*3·9*
Technology	306	2	*0·7*	305	5	*1·6*
Science	7 327	367	*5·0*	6 790	455	*6·7*
Research councils[1]						
All subjects	1 756	153	*8·7*	2 939	270	*9·2*
Engineering	63	2	*3·8*	271	22	*8·1*
Technology	2	—	—	5	—	—
Science	1 701	161	*8·9*	2 663	248	*9·3*
Atomic Energy Authority						
All subjects	6 031	79	*1·6*	4 685	82	*1·8*
Engineering	2 481	3	*0·1*	2 270	34	*1·5*
Technology	309	9	*2·9*	272	1	*0·4*
Science	2 241	67	*3·0*	2143	47	*2·2*
Local authorities						
All subjects	9 650	1 701	*17·6*	11 725	1 890	*16·1*
Engineering	8 835	1 625	*18·4*	10 722	1 835	*17·1*
Technology	120	31	*25·8*	146	—	—
Science	695	45	*6·5*	867	55	*6·4*
EDUCATION						
Universities[2]						
All subjects	13 885	780	*5·6*	18 672	671	*3·6*
Engineering	2 719	229	*8·4*	3 388	152	*4·5*
Technology	461	38	*8·2*	591	23	*3·9*
Science	10 705	513	*4·8*	14 713	496	*3·4*

(1) Data for 1965 are not strictly comparable with 1968. See general notes.

(2) 1965 data include colleges of advanced technology.

Persons holding degree or equivalent qualifications in engineering, technology and science

ALL FIELDS OF EMPLOYMENT IN SURVEY

Analysis by subject of qualification held; 1965, 1968 and forecast 1971

Table S5

	All subjects				Engineering						Technology		Science						
	All subjects	Engineering	Technology	Science	Chemical engineering	Civil and structural engineering	Electrical engineering	Mechanical engineering	Mining engineering	Other engineering	Metallurgy	Other technologies	Agriculture	Biology	Chemistry	Geology	Mathematics	Physics	General science or other sciences
ALL FIELDS OF EMPLOYMENT IN SURVEY																			
1965	211 278	108 255	12 703	90 320	5 888	19 510	29 315	44 841	2 884	5 817	6 162	6 541	4 840	9 267	31 582	1 591	18 368	16 336	8 336
1968	240 134	123 593	13 869	102 672	8 126	22 344	33 125	48 363	2 802	10 833	6 973	7 896	5 052	10 918	35 122	2 086	20 308	18 338	10 850
1971	278 905	147 418	18 232	116 255	7 968	28 392	38 600	55 533	2 686	14 237	8 737	9 496	6 629	12 458	39 259	2 307	22 852	20 613	12 237
INDUSTRY																			
Manufacturing																			
1965	98 540	56 947	10 100	31 493	3 160	1 968	15 320	31 896	434	4 169	4 734	5 368	1 614	857	17 558	135	2 278	5 280	3 771
1968	111 276	64 395	10 288	36 595	3 382	1 998	16 978	33 948	408	7 683	4 293	5 993	1 524	1 128	19 206	295	3 460	6 060	4 923
1971	134 558	79 119	12 313	43 128	4 748	2 363	20 724	40 141	431	10 712	4 988	7 325	1 612	1 514	22 084	273	4 525	7 354	5 764
Construction																			
1965	7 190	8 928	89	173	38	6 676	465	470	123	158	2	87	—	—	30	14	9	24	96
1968	9 670	8 630	682	358	9	7 157	403	527	120	414	8	674	4	—	95	50	22	30	157
1971	12 399	11 167	843	389	13	9 422	650	635	80	467	8	836	4	—	105	56	27	34	163
Industrial research associations[1]																			
1965	2 230	597	335	1 298	32	87	156	320	2	21	201	134	9	143	608	22	89	428	99
1968	2 175	748	314	1 113	44	65	133	442	2	62	222	92	5	53	459	7	80	310	199
1971	2 551	928	368	1 255	63	77	154	548	1	85	240	128	5	64	503	7	114	362	200
NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS																			
1965	19 180	17 333	211	1 638	2 045	1 258	8 631	2 861	1 779	759	144	67	9	18	654	55	256	449	195
1968	22 385	19 451	359	2 575	1 981	1 191	10 142	3 852	1 692	593	207	152	17	23	1 010	69	377	656	423
1971	24 539	21 416	374	2 749	2 351	1 573	11 048	4 293	1 569	582	222	152	15	20	1 057	54	421	665	517
GOVERNMENT																			
Total																			
1965	32 383	19 682	737	11 964	273	9 437	3 492	5 757	191	532	524	213	1 724	1 296	3 110	327	1 427	2 665	1 416
1968	34 321	21 140	728	12 453	252	10 950	3 354	5 249	182	1 153	609	219	1 594	1 486	3 104	394	1 477	2 828	1 570
1971	38 507	24 419	667	13 421	279	13 808	3 691	5 100	172	1 369	485	182	1 813	1 785	3 275	541	1 617	2 836	1 655

Table S5 (continued)

	All subjects				Technology							Science						
	All subjects	Engineering	Technology	Science	Chemical engineering	Civil and structural engineering	Electrical engineering	Mechanical engineering	Mining engineering	Other engineering	Metallurgy	Other technologies	Agriculture	Biology	Chemistry	Geology	Mathematics	Physics	General science or other sciences
Government departments[1]																			
1965	15 946	8 313	306	7 327	148	1 355	2 531	3 905	165	209	222	84	1 335	599	1 568	273	1 079	1 536	938
1968	14 972	7 877	305	6 790	127	1 094	2 466	3 407	151	632	238	67	1 182	595	1 603	113	1 015	1 437	845
1971	15 484	6 080	275	7 129	121	1 347	2 420	3 263	140	789	233	42	1 330	686	1 678	122	1 015	1 427	871
Reseerch councils[1]																			
1985	1 756	63	2	1 701	4	—	15	34	—	—	2	—	292	647	456	22	80	126	79
1968	2 939	271	5	2 663	1	8	143	106	3	11	2	3	296	830	417	240	161	424	295
1971	3 627	309	5	3 313	1	12	161	111	6	19	2	3	365	1 039	484	371	203	493	368
Atomic Energy Authority																			
1965	5 031	2 481	309	2 241	108	109	691	1 532	2	39	296	13	7	9	778	4	205	952	286
1986	4 685	2 270	272	2 143	114	103	844	1 300	—	109	267	5	4	14	720	7	216	929	253
1971	4 448	2 168	253	2 027	119	101	622	1 220	—	106	248	5	4	13	687	6	202	877	238
Locel euthorities																			
1965	9 650	8 835	120	695	13	7 973	266	286	24	284	4	116	90	41	308	28	63	53	112
1968	11 725	10 722	146	857	10	9 745	101	437	28	401	2	144	112	47	384	34	85	38	177
1871	14 946	13 862	134	952	38	12 348	488	508	27	465	2	132	124	47	426	42	97	38	178
EDUCATION																			
Total																			
1965	61 755	6 768	1 231	43 756	342	1 104	1 262	3 537	355	178	557	674	1 484	6 953	9 722	1 038	14 309	7 490	2 760
1968	60 307	9 229	1 600	49 578	458	983	2 115	4 347	398	928	734	766	1 908	8 228	11 249	1 271	14 892	8 452	3 678
1971	66 351	10 369	1 667	54 315	514	1 149	2 433	4 816	435	1 022	794	873	2 180	9 075	12 235	1 376	16 248	9 263	3 938
Universities[2]																			
1985	13 885	2 719	461	10 705	255	522	740	948	100	154	322	139	501	2 440	3 023	475	1 485	2 065	726
1968	18 672	3 368	591	14 713	290	598	927	1 111	66	356	421	170	670	3 291	4 022	812	2 116	2 808	1 194
1971	21 355	3 868	681	16 806	334	703	1 109	1 232	90	400	454	227	772	3 831	4 445	880	2 644	3 156	1 378
Schools end further educetion establishments																			
1965	37 870	4 049	770	33 051	87	582	612	2 589	255	24	235	535	983	4 513	6 699	683	12 824	6 435	2 034
1968	41 635	5 861	909	34 865	168	385	1 188	3 236	312	572	313	596	1 238	4 937	7 227	659	12 776	5 644	2 384
1971	44 996	8 501	986	37 509	180	446	1 324	3 684	345	622	340	646	1 408	6 244	7 790	696	13 704	6 107	2 560

(1) Data for 1965 are not strictly comparable with 1968. See general notes.

(2) Data for 1965 include colleges of advanced technology.

MANUFACTURING IN SURVEY*

Analysis by research and development and other functions, 1962, 1965, 1968 and forecast 1971

Table 56

	All subjects					Engineering					Technology					Science				
	All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions	
				R & D	Other				R & D	Other				R & D	Other				R & D	Other
ALL MANUFACTURING IN SURVEY																				
1962	86 221	31 837	54 384	*36·9*	*63·1*	61 498	14 769	36 729	*28·7*	*71·3*	8 946	2 878	6 068	*32·2*	*67·8*	25 777	14 190	11 587	*55·0*	*45·0*
1865	98 540	37 124	61 416	*37·7*	*62·3*	56 947	17 795	39 152	*31·2*	*68·8*	10 100	3 065	7 045	*30·2*	*69·8*	31 493	16 274	15 219	*51·7*	*48·3*
1968	111 278	38 914	72 362	*35·0*	*65·0*	64 395	17 811	46 584	*27·7*	*72·3*	10 286	2 836	7 450	*27·6*	*72·4*	36 585	18 267	18 328	*49·9*	*50·1*
1971	134 658					79 119					12 313					43 126				
Food, drink and tobacco																				
1962	3 016	1 180	1 836	*39·1*	*60·9*	908	181	727	*19·9*	*80·1*	156	30	126	*19·2*	*80·8*	1 952	969	983	*49·6*	*50·4*
1965	4 584	1 309	3 275	*28·6*	*71·4*	1 272	232	1 040	*18·2*	*81·8*	462	62	400	*13·4*	*86·6*	2 850	1 015	1 835	*35·6*	*64·4*
1968	5 114	1 373	3 741	*26·8*	*73·2*	1 381	217	1 164	*15·7*	*84·3*	722	108	614	*15·0*	*85·0*	3 011	1 048	1 983	*34·8*	*65·2*
1971	6 007					1 652					885					3 470				
Chemicals and allied industries (excluding mineral oil refining)																				
1962	16 145	6 447	9 698	*39·9*	*60·1*	4 350	721	3 629	*16·6*	*83·4*	487	229	258	*47·0*	*53·0*	11 308	5 497	5 811	*48·6*	*51·4*
1965	17 415	7 195	10 220	*41·3*	*58·7*	4 653	814	3 839	*17·5*	*82·5*	503	229	274	*45·5*	*54·5*	12 259	6 152	8 107	*50·2*	*49·8*
1968	19 920	8 677	11 243	*43·6*	*56·4*	4 970	859	4 111	*17·3*	*82·7*	527	200	327	*38·0*	*62·0*	14 423	7 818	6 805	*52·8*	*47·2*
1971	23 560					6 272					599					18 889				
Mineral oil refining																				
1962	1 924	768	1 156	*39·9*	*60·1*	1 035	235	800	*22·7*	*77·3*	30	7	23	*23·3*	*76·7*	859	526	333	*61·2*	*38·8*
1965	2 492	1 104	1 388	*44·3*	*55·7*	1 242	322	920	*25·9*	*74·1*	43	20	23	*46·5*	*53·5*	1 207	762	445	*63·1*	*36·9*
1968	2 524	868	1 656	*34·4*	*65·6*	1 286	242	1 044	*18·8*	*81·2*	33	8	26	*24·2*	*75·8*	1 205	618	587	*51·3*	*48·7*
1971	2 688					1 410					31					1 247				
Metal manufacture																				
1962	6 076	1 618	4 457	*26·6*	*73·4*	2 821	390	2 431	*13·8*	*86·2*	2 265	747	1 518	*33·0*	*67·0*	989	481	508	*48·6*	*51·4*
1965	7 213	2 172	5 041	*30·1*	*69·9*	3 170	655	2 616	*20·7*	*79·3*	2 997	1 056	1 941	*35·2*	*64·8*	1 048	461	685	*44·1*	*55·9*
1968	7 547	1 755	5 792	*23·3*	*76·7*	3 376	419	2 957	*12·4*	*87·6*	2 823	854	1 969	*30·3*	*69·7*	1 348	482	866	*35·8*	*64·2*
1971	8 665					3 867					3 260					1 538				
Mechanical engineering																				
1962	19 282	4 874	14 408	*25·3*	*74·7*	15 854	3 214	12 640	*20·3*	*79·7*	1 634	560	1 074	*34·3*	*65·7*	1 794	1 100	694	*61·3*	*38·7*
1965	21 278	5 176	16 102	*24·3*	*75·7*	17 395	3 633	13 762	*20·9*	*79·1*	1 501	439	1 062	*29·2*	*70·8*	2 382	1 104	1 278	*46·3*	*53·7*
1968	23 335	5 083	18 272	*21·7*	*78·3*	19 460	3 605	15 855	*18·5*	*81·5*	1 267	433	834	*34·2*	*65·8*	2 608	1 025	1 583	*39·3*	*60·7*
1971	28 717					24 076					1 492					3 149				
Electrical engineering and electronics																				
1962	18 045	8 601	9 444	*47·7*	*52·3*	13 826	5 449	8 377	*39·4*	*60·6*	608	432	178	*71·1*	*28·9*	3 611	2 720	891	*75·3*	*24·7*
1965	21 048	10 621	10 427	*50·5*	*49·5*	15 269	6 911	8 358	*45·3*	*54·7*	369	217	152	*58·8*	*41·2*	6 410	3 493	1 917	*64·6*	*35·4*
1968	24 922	10 540	14 382	*42·3*	*57·7*	17 848	8 748	11 100	*37·8*	*62·2*	384	226	158	*58·9*	*41·1*	6 690	3 568	3 124	*53·3*	*46·7*
1971	30 924					22 096					488					8 340				

* The survey covered 92 per cent of estimated employment. See Table 39.

Table S6 (continued)

	All subjects					Engineering					Technology					Science				
	All functions	Research and development	Other	*Per cent of all functions*		All functions	Research and development	Other	*Per cent of all functions*		All functions	Research and development	Other	*Per cent of all functions*		All functions	Research and development	Other	*Per cent of all functions*	
				R & D	*Other*				*R & D*	*Other*				*R & D*	*Other*				*R & D*	*Other*
Electricel engineering																				
1986	9 214	3 485	5 729	*37·8*	*62·2*	7 660	2 420	5 140	*32·0*	*68·0*	272	164	108	*60·3*	*39·7*	1 382	901	481	*65·2*	*34·8*
1968	8 647	2 460	6 087	*28·8*	*71·2*	7 104	1 704	5 400	*24·0*	*76·0*	261	143	118	*54·8*	*45·2*	1 182	613	569	*51·9*	*48·1*
1971	9 528					7 895					303					1 330				
Electronics																				
1965	11 834	7 136	4 898	*60 3*	*39·7*	7 709	4 491	3 218	*58·3*	*41·7*	97	53	44	*54·6*	*45·4*	4 028	2 592	1 436	*64·3*	*35·7*
1968	16 375	8 080	8 295	*49·3*	*50·7*	10 744	5 044	5 700	*46·9*	*53·1*	123	83	40	*67·5*	*32·5*	5 508	2 953	2 655	*53 6*	*46·4*
1971	21 396					14 201					185					7 010				
Aircreft																				
1962	7 061	4 014	3 047	*56·8*	*43 2*	5 507	3 060	2 447	*55·6*	*44·4*	430	211	219	*49·1*	*50·9*	1 124	743	381	*66 1*	*33·9*
1966	6 888	4 192	2 694	*60·9*	*39·1*	6 435	3 273	2 162	*60·2*	*39·8*	267	143	124	*53 6*	*46 4*	1 184	776	408	*65·5*	*34·5*
1968	7 183	4 323	2 860	*60·2*	*39·8*	5 687	3 280	2 407	*57·7*	*42 3*	212	107	105	*50·5*	*49 5*	1 284	936	348	*72·9*	*27·1*
1971	8 693					6 897					245					1 561				
Motor vehicles																				
1962	2 001	585	1 438	*28·2*	*71·8*	1 797	493	1 304	*27·4*	*72·6*	152	49	103	*32·2*	*67·8*	52	23	29	*44·2*	*55·8*
1966	2 811	712	2 099	*25·3*	*74·7*	2 415	627	1 788	*26·0*	*74·0*	239	47	192	*19·7*	*80 3*	157	38	119	*24 2*	*75·8*
1968	2 995	858	2 137	*28·6*	*71·4*	2 595	718	1 877	*27·7*	*72·3*	182	83	99	*45·6*	*54 4*	218	57	161	*26·1*	*73·9*
1971	3 953					3 398					241					314				
Other vehicles																				
1962	2 298	369	1 929	*16·1*	*83·9*	2 122	318	1 804	*15·0*	*85·0*	109	8	101	*7·3*	*92·7*	67	43	24	*64·2*	*35·8*
1966	1 950	343	1 607	*17·6*	*82·4*	1 816	315	1 500	*17·4*	*82·6*	63	1	62	*1·6*	*98·8*	72	27	45	*37·5*	*62·5*
1968	2 729	791	1 938	*29·0*	*71·0*	2 447	597	1 850	*24·4*	*75·6*	18	1	17	*5·6*	*94 4*	264	193	71	*73·1*	*28·9*
1971	3 025					2 715					22					288				
Textiles, clothing etc.																				
1962	4 729	1 340	3 389	*28·3*	*71·7*	881	220	661	*25·0*	*75·0*	2 237	364	1 873	*16·3*	*83·7*	1 611	766	855	*46·9*	*53·1*
1965	6 166	1 498	3 658	*29·1*	*70·9*	942	232	710	*24·6*	*75·4*	2 182	353	1 829	*16 2*	*83·8*	2 032	913	1 119	*44·9*	*55·1*
1968	5 979	1 728	4 253	*28·9*	*71·1*	1 251	332	919	*26·5*	*73·6*	2 411	353	2 058	*14·6*	*85·4*	2 317	1 041	1 276	*44·9*	*55·1*
1971	7 173					1 505					3 065					2 603				
Other manufecturing																				
1962	5 645	2 061	3 584	*36·5*	*63·5*	2 397	488	1 909	*20·4*	*79·6*	838	241	597	*28·8*	*71·2*	2 410	1 332	1 078	*55·3*	*44·7*
1965	7 707	2 802	4 905	*36·4*	*63·6*	3 339	781	2 658	*23·4*	*76·6*	1 474	488	986	*33·1*	*66·9*	2 894	1 533	1 361	*53·0*	*47·0*
1968	9 028	2 940	6 088	*32·6*	*67·4*	4 094	794	3 300	*19·4*	*80·6*	1 707	463	1 244	*27·1*	*72·9*	3 227	1 683	1 544	*52·2*	*47·8*
1971	11 153					5 231					1 985					3 937				

Persons holding degree or equivelent quelifications in engineering, technology end science

MANUFACTURING IN SURVEY

Change in numbers amployed between 1962 and 1965, 1965 and 1968 and forecast 1968 to 1971

Table S7

	1962 to 1965			1966 to 1968			Forecast 1988 to 1971		
	Number in 1962	Change between 1962 and 1965	*Change as a per cent of 1962*	Number in 1965	Change between 1965 and 1968	*Change as a per cent of 1965*	Number in 1968	Forecast change between 1968 and 1971	*Change as a per cent of 1968*
ALL MANUFACTURING IN SURVEY									
All subjects	86 221	12 319	*14·3*	98 540	12 736	*12·9*	111 276	23 282	*20 9*
Engineering	51 498	5 449	*10·6*	56 947	7 448	*13·1*	64 395	14 724	*22·9*
Technology	8 946	1 154	*12·9*	10 100	186	*1·8*	10 286	2 027	*19·7*
Science	25 777	5 716	*22·2*	31 493	5 102	*16·2*	36 595	6 631	*17·8*
Food, drink end tobacco									
All subjects	3 016	1 568	*52·0*	4 584	530	*11·6*	5 114	893	*17·5*
Engineering	908	364	*40·1*	1 272	109	*8·6*	1 381	271	*19·6*
Technology	156	306	*196·2*	462	260	*56·3*	722	163	*22·6*
Science	1 952	898	*46·0*	2 850	161	*5·6*	3 011	459	*15·2*
Chemicals end allied industries (excluding mineral oil refining)									
All subjects	18 145	1 270	*7·9*	17 415	2 505	*14·4*	19 920	3 640	*18·3*
Engineering	4 350	303	*7·0*	4 653	317	*6·8*	4 970	1 302	*26·2*
Technology	487	16	*3·3*	503	24	*4·8*	527	72	*13·7*
Science	11 308	951	*8·4*	12 259	2 164	*17·7*	14 423	2 266	*15·7*
Mineral oil refining									
All subjects	1 924	568	*29·5*	2 492	32	*1·3*	2 524	164	*6·6*
Engineering	1 035	207	*20·0*	1 242	44	*3·5*	1 286	124	*9·6*
Technology	30	13	*43·3*	43	— 10	*—23·3*	33	—2	*—6·1*
Science	859	348	*40·5*	1 207	— 2	— 0·2	1 205	42	*3·5*
Metal menufacture									
All subjects	6 075	1 138	*18·7*	7 213	334	*4·6*	7 547	1 118	*14·8*
Engineering	2 821	349	*12·4*	3 170	206	*6·5*	3 378	491	*14·5*
Technology	2 265	732	*32·3*	2 997	—174	*— 5·8*	2 823	437	*15·5*
Science	989	57	*5·8*	1 046	302	*28·9*	1 348	190	*14·1*
Mechenical engineering									
All subjects	19 282	1 996	*10·4*	21 278	2 057	*9·7*	23 335	5 382	*23·1*
Engineering	15 854	1 541	*9·7*	17 395	2 065	*11·9*	19 460	4 818	*23·7*
Technology	1 634	—133	*— 8·1*	1 501	—234	*—15·6*	1 267	225	*17·8*
Science	1 794	588	*32·8*	2 382	226	*9·5*	2 608	541	*20·7*
Electrical engineering and electronics									
All subjects	18 045	3 003	*16·6*	21 048	3 874	*18·4*	24 922	6 002	*24·1*
Engineering	13 826	1 443	*10·4*	15 269	2 579	*16·9*	17 848	4 248	*23·8*
Technology	608	—239	*—39·3*	369	15	*4·1*	384	104	*27·1*
Science	3 611	1 799	*49·8*	5 410	1 280	*23·7*	6 690	1 650	*24·7*

Table S7 (continued)

	1962 to 1965			1965 to 1968			Forecast 1968 to 1971		
	Number in 1962	Change between 1962 and 1965	*Change as a per cent of 1962*	Number in 1965	Change between 1965 and 1968	*Change as a per cent of 1965*	Number in 1968	Forecast change between 1968 and 1971	*Change as a per cent of 1968*
Electrical engineering									
All subjects	..	..	..	9 214	—667	*— 7·2*	8 547	981	*11·5*
Engineering	..	..	..	7 560	—456	*— 6·0*	7 104	791	*11·1*
Technology	..	..	..	272	— 11	*— 4·0*	261	42	*16·1*
Science	..	..	..	1 382	—200	*—14·5*	1 182	148	*12·5*
Electronics									
All subjects	..	..	..	11 834	4 541	*38·4*	16 375	5 021	*30·7*
Engineering	..	..	..	7 709	3 035	*39·4*	10 744	3 457	*32·2*
Technology	..	..	..	97	26	*26·8*	123	62	*50·4*
Science	..	..	..	4 028	1 480	*36·7*	5 508	1 502	*27·3*
Aircraft									
All subjects	7 061	—175	*— 2·5*	6 886	297	*4·3*	7 183	1 510	*21·0*
Engineering	5 507	— 72	*— 1·3*	5 435	252	*4·6*	5 687	1 210	*21·3*
Technology	430	—163	*—37·9*	287	— 55	*—20·6*	212	33	*15·6*
Science	1 124	60	*5·3*	1 184	100	*3·4*	1 284	267	*20·8*
Motor vehicles									
All subjects	2 001	810	*40·5*	2 811	184	*6·5*	2 995	958	*32·0*
Engineering	1 797	818	*34·4*	2 415	180	*7·5*	2 695	803	*30·9*
Technology	152	87	*57·2*	239	— 57	*—23·8*	182	59	*32·4*
Science	52	105	*201·9*	157	61	*38·9*	218	96	*44·0*
Other vehicles									
All subjects	2 298	—348	*—15·1*	1 950	779	*39·9*	2 729	296	*10·8*
Engineering	2 122	—307	*—14·5*	1 815	632	*34·8*	2 447	268	*11·0*
Technology	109	— 48	*—42·2*	63	— 45	*—71·4*	18	4	*22·2*
Science	67	5	*7·5*	72	192	*266·7*	264	24	*9·1*
Textiles, clothing etc.									
All subjects	4 729	427	*9·0*	5 156	823	*16·0*	5 979	1 194	*20·0*
Engineering	881	61	*6·9*	942	309	*32·8*	1 251	254	*20·3*
Technology	2 237	— 55	*— 2·5*	2 182	229	*10·5*	2 411	854	*27·1*
Science	1 611	421	*26·1*	2 032	285	*14·0*	2 317	286	*12·3*
Other manufacturing									
All subjects	5 645	2 082	*36·5*	7 707	1 321	*17·1*	9 028	2 125	*23·5*
Engineering	2 397	942	*39·3*	3 339	755	*22·6*	4 094	1 137	*27·8*
Technology	838	838	*75·9*	1 474	233	*15·8*	1 707	278	*16·3*
Science	2 410	484	*20·1*	2 894	333	*11·5*	3 227	710	*22·0*

Persons holding degree or equivalent qualifications in engineering, technology and science

MANUFACTURING IN SURVEY

Vacancies reported by employers at January 1965 and January 1968

Table S8

	1965			1968		
	QSEs employed	Vacancies	*Vacancies as a per cent of QSEs employed*	QSEs employed	Vacancies	*Vacancies as a per cent of QSEs employed*
ALL MANUFACTURING IN SURVEY						
All subjects	98 640	9 067	*9·2*	111 276	6 928	*6·2*
Engineering	56 947	6 941	*10·4*	64 395	4 244	*6·6*
Technology	10 100	613	*6·1*	10 286	526	*5·1*
Science	31 493	2 513	*8·0*	36 596	2 168	*5·9*
Food, drink and tobacco						
All subjects	4 584	247	*5·4*	5 114	254	*5·0*
Engineering	1 272	60	*4·7*	1 381	74	*5·4*
Technology	462	14	*3·0*	722	22	*3·0*
Science	2 850	173	*6·1*	3 011	158	*5·2*
Chemicals and allied industries (excluding mineral oil refining)						
All subjects	17 415	1 044	*6·0*	19 920	1 004	*5·0*
Engineering	4 653	215	*4·6*	4 970	297	*6·0*
Technology	503	84	*16·7*	527	34	*6·5*
Science	12 259	745	*6·1*	14 423	673	*4·7*
Mineral oil refining						
All subjects	2 492	179	*7·2*	2 524	86	*3·4*
Engineering	1 242	69	*5·6*	1 286	58	*4·4*
Technology	43	2	*4·7*	33	—	—
Science	1 207	108	*8·9*	1 205	30	*2·5*
Metal manufacture						
All subjects	7 213	716	*9·9*	7 547	294	*3·9*
Engineering	3 170	385	*12·1*	3 376	136	*4·0*
Technology	2 997	201	*6·7*	2 823	104	*3·7*
Science	1 046	130	*12·4*	1 348	54	*4·0*
Mechanical engineering						
All subjects	21 278	2 080	*9·8*	23 335	1 255	*5·4*
Engineering	17 395	1 815	*10·4*	19 460	1 024	*5·3*
Technology	1 501	85	*5·7*	1 267	56	*4·4*
Science	2 382	180	*7·6*	2 608	175	*6·7*
Electrical engineering and electronics						
All subjects	21 048	3 079	*14·6*	24 922	2 112	*8·5*
Engineering	15 269	2 367	*15·5*	17 848	1 525	*8·5*
Technology	369	43	*11·7*	384	8	*2·1*
Science	6 410	669	*12·4*	6 690	579	*8·7*

Table S8 (continued)

	1966			1868		
	QSEs employed	Vacancies	*Vacancies as a per cent of QSEs employed*	QSEs employed	Vacancies	*Vacancies as a per cent of QSEs employed*
Electrical engineering						
All subjects	9 214	1 012	*11·0*	8 647	355	*4·2*
Engineering	7 660	881	*11·7*	7 104	316	*4·4*
Technology	272	20	*7·4*	261	5	*1·9*
Science	1 382	111	*8·0*	1 182	34	*2·9*
Electronics						
All subjects	11 834	2 067	*17·5*	18 376	1 757	*10·7*
Engineering	7 709	1 488	*19·3*	10 744	1 209	*11·3*
Technology	97	23	*23·7*	123	3	*2·4*
Science	4 028	558	*13·9*	5 508	546	*9·9*
Aircraft						
All subjects	6 886	481	*7·0*	7 183	782	*10·9*
Engineering	5 435	325	*6·0*	5 687	621	*10·9*
Technology	267	10	*3·7*	212	7	*3·3*
Science	1 184	148	*12·3*	1 284	154	*12·0*
Motor vehicles						
All subjects	2 811	297	*10·6*	2 995	160	*5·3*
Engineering	2 415	246	*10·2*	2 595	129	*5·0*
Technology	239	18	*7·5*	182	10	*5·5*
Science	157	33	*21·0*	218	21	*9 6*
Other vehicles						
All subjects	1 950	208	*10·6*	2 729	124	*4·5*
Engineering	1 815	192	*10·6*	2 447	107	*4·4*
Technology	63	10	*15·9*	18	1	*5·6*
Science	72	4	*5·6*	264	18	*6·1*
Textiles, clothing, etc.						
All subjects	5 156	230	*4·5*	5 979	451	*7·5*
Engineering	942	45	*4·8*	1 251	90	*7·2*
Technology	2 182	92	*4·2*	2 411	227	*9 4*
Science	2 032	93	*4 6*	2 317	134	*5·8*
Other manufacturing						
All subjects	7 707	508	*6·6*	9 028	406	*4·5*
Engineering	3 339	222	*6·6*	4 094	185	*4·5*
Technology	1 474	54	*3·7*	1 707	57	*3·3*
Science	2 894	232	*8·0*	3 227	164	*5·1*

MANUFACTURING IN SURVEY

Number of QSEs employed as a percentage of all employees (density) in 1962, 1965 and 1968

Table S9

	1962		1965		1968	
	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*
ALL MANUFACTURING IN SURVEY						
Total employees	8 133 000		8 069 000		7 856 000	
QSEs						
All subjects	86 221	*1·1*	98 540	*1·2*	111 276	*1·4*
Engineering	51 498	*0·6*	66 947	*0·7*	84 395	*0·8*
Technology	8 946	*0·1*	10 100	*0·1*	10 286	*0·1*
Science	25 777	*0·3*	31 493	*0·4*	36 595	*0·5*
Food, drink end tobecco						
Total employees	724 000		714 000		721 000	
QSEs						
All subjects	3 018	*0·4*	4 584	*0·6*	5 114	*0·7*
Engineering	908	*0·1*	1 272	*0·2*	1 381	*0·2*
Technology	166	—	462	*0·1*	722	*0·1*
Science	1 952	*0·3*	2 850	*0·4*	3 011	*0·4*
Chemicels end ellied industries (excluding mineral oil refining)						
Total employees	416 000		410 000		403 000	
QSEs						
All subjects	16 145	*3·9*	17 415	*4·2*	19 920	*4·9*
Engineering	4 350	*1·0*	4 653	*1·1*	4 970	*1·2*
Technology	487	*0·1*	503	*0·1*	527	*0·1*
Science	11 308	*2·7*	12 259	*3·0*	14 423	*3·6*
Mineral oil refining						
Total employees	30 000		27 000		28 000	
QSEs						
All subjects	1 924	*6·4*	2 492	*9·2*	2 524	*9·0*
Engineering	1 035	*3·5*	1 242	*4·6*	1 286	*4·6*
Technology	30	*0·1*	43	*0·2*	33	*0·1*
Science	859	*2·9*	1 207	*4·5*	1 205	*4·3*
Metel msnufecture						
Total employees	595 000		602 000		582 000	
QSEs						
All subjects	6 075	*1·0*	7 213	*1·2*	7 547	*1·3*
Engineering	2 821	*0·5*	3 170	*0·5*	3 378	*0·6*
Technology	2 265	*0·4*	2 997	*0·5*	2 623	*0·5*
Science	989	*0·2*	1 048	*0·2*	1 348	*0·2*

Table S9 (continued)

	1962		1965		1968	
	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*
Mechanical engineering						
Total employees	1 766 000		1 772 000		1 778 000	
QSEs						
All subjects	19 282	*1·1*	21 278	*1·2*	23 335	*1·3*
Engineering	15 854	*0·9*	17 395	*1·0*	19 460	*1·1*
Technology	1 634	*0·1*	1 501	*0·1*	1 267	*0·1*
Science	1 794	*0·1*	2 382	*0·1*	2 608	*0·1*
Electrical engineering and electronics						
Total employees	753 000		808 000		825 000	
QSEs						
All subjects	18 045	*2·4*	21 048	*2·6*	24 922	*3·0*
Engineering	13 828	*1·8*	15 269	*1·9*	17 848	*2·2*
Technology	608	*0·1*	369	—	384	—
Science	3 611	*0·5*	5 410	*0·7*	6 690	*0·8*
Electrical engineering						
Total employees	461 000		478 000		461 000	
QSEs						
All subjects	..	..	9 214	*1·9*	8 547	*1·9*
Engineering	..	..	7 560	*1·6*	7 104	*1·6*
Technology	..	..	272	*0·1*	261	*0·1*
Science	..	..	1 382	*0·3*	1 182	*0·3*
Electronics						
Total employees	292 000		330 000		374 000	
QSEs						
All subjects	..	..	11 834	*3·6*	16 375	*4·4*
Engineering	..	..	7 709	*2·3*	10 744	*2·9*
Technology	..	..	97	—	123	—
Science	..	..	4 028	*1·2*	6 508	*1·5*
Aircraft						
Total employees	287 000		264 000		238 000	
QSEs						
All subjects	7 061	*2·5*	8 886	*2·7*	7 183	*3·0*
Engineering	6 607	*1·9*	5 435	*2·1*	5 687	*2·4*
Technology	430	*0·1*	267	*0·1*	212	*0·1*
Science	1 124	*0·4*	1 184	*0·5*	1 284	*0·5*

MANUFACTURING IN SURVEY

Number of QSEs employed as a percentage of all employees (density) in 1962, 1965 and 1968

Table S9 (continued)

	1962		1965		1968	
	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*
Motor vehicles						
Total employees	434 000		504 000		435 000	
QSEs						
All subjects	2 001	*0·5*	2 811	*0·6*	2 995	*0·7*
Engineering	1 797	*0·4*	2 416	*0·5*	2 595	*0·6*
Technology	152	—	239	—	182	—
Science	52	—	157	—	218	*0·1*
Other vehicles						
Total employees	232 000		190 000		171 000	
QSEs						
All subjects	2 298	*1·0*	1 950	*1·0*	2 729	*1·6*
Engineering	2 122	*0·9*	1 815	*1·0*	2 447	*1·4*
Technology	109	—	63	—	18	—
Science	67	—	72	—	264	*0·2*
Textiles, clothing, etc.						
Total employees	1 432 000		1 295 000		1 192 000	
QSEs						
All subjects	4 729	*0·3*	5 156	*0·4*	5 979	*0·5*
Engineering	881	*0·1*	942	*0·1*	1 251	*0·1*
Technology	2 237	*0·2*	2 182	*0·2*	2 411	*0·2*
Science	1 611	*0·1*	2 032	*0·2*	2 317	*0·2*
Other manufacturing						
Total employees	1 463 000		1 493 000		1 483 000	
QSEs						
All subjects	5 645	*0·4*	7 707	*0·5*	9 028	*0·6*
Engineering	2 397	*0·2*	3 339	*0·2*	4 094	*0·3*
Technology	838	*0·1*	1 474	*0·1*	1 707	*0·1*
Science	2 410	*0·2*	2 894	*0·2*	3 227	*0·2*

Persons holding degree or equivalent qualifications in engineering, technology and science

MANUFACTURING IN SURVEY

Analysis by subject of qualification held, 1965, 1968 and forecast 1971

Table S10

	All subjects				Engineering						Technology		Science						
	All subjects	Engineering	Technology	Science	Chemical engineering	Civil and structural engineering	Electrical engineering	Mechanical engineering	Mining engineering	Other engineering	Metallurgy	Other technologies	Agriculture	Biology	Chemistry	Geology	Mathematics	Physics	General science or other sciences
ALL MANUFACTURING IN SURVEY																			
1965	98 540	56 947	10 100	31 493	3 160	1 968	15 320	31 896	434	4 159	4 734	5 366	1 614	857	17 558	135	2 276	5 280	3 771
1968	111 276	64 395	10 286	36 595	3 382	1 998	16 978	33 946	408	7 683	4 293	5 993	1 524	1 128	19 205	295	3 460	6 060	4 923
1971	134 556	79 119	12 313	43 126	4 748	2 363	20 724	40 141	431	10 712	4 988	7 325	1 612	1 514	22 084	273	4 525	7 354	5 754
Food, drink and tobacco																			
1965	4 564	1 272	462	2 860	150	55	94	901	3	69	6	456	828	180	1 395	1	106	93	248
1968	5 114	1 381	722	3 011	159	46	151	853	6	166	5	717	626	176	1 886	7	137	75	304
1971	6 007	1 652	665	3 470	196	79	182	951	6	228	4	881	636	226	1 951	6	203	96	352
Chemicals and allied industries (excluding mineral oil refining)																			
1965	17 415	4 653	503	12 259	1 421	251	420	2 376	53	132	118	385	646	610	9 773	17	281	495	437
1968	19 920	4 970	527	14 423	1 252	279	468	2 642	82	247	94	433	712	829	11 009	69	344	601	859
1971	23 660	5 272	599	16 689	2 113	299	636	2 923	82	319	89	510	768	1 159	12 576	18	464	652	1 052
Mineral oil refining																			
1965	2 492	1 242	43	1 207	323	58	99	725	6	31	15	28	1	5	902	31	50	117	101
1968	2 524	1 286	33	1 205	330	60	115	738	12	41	23	10	1	4	854	51	85	119	111
1971	2 588	1 410	31	1 247	356	57	126	812	13	46	24	7	—	5	880	54	75	125	108
Metal manufacture																			
1965	7 213	3 170	2 997	1 046	141	192	461	2 096	39	241	2 835	182	1	7	467	20	136	230	185
1968	7 647	3 378	2 823	1 348	155	218	455	2 010	42	466	2 602	221	12	12	538	35	202	256	293
1971	8 655	3 867	3 260	1 538	201	222	545	2 250	33	616	3 016	244	11	11	625	38	240	266	327
Mechenicel engineering																			
1965	21 276	17 395	1 501	2 382	632	947	1 589	12 382	250	1 595	1 090	411	48	13	800	21	187	620	693
1968	23 335	19 460	1 267	2 608	916	867	1 603	12 565	164	3 345	924	343	54	22	849	32	306	592	753
1971	26 717	24 076	1 492	3 149	1 161	1 063	2 076	14 676	205	4 895	1 066	406	64	23	1 068	13	384	744	653
Electrical engineering and electronics																			
1965	21 048	15 269	369	5 410	23	35	11 138	3 456	24	593	221	148	4	1	881	5	822	2 511	1 186
1968	24 922	17 848	384	6 690	95	47	12 552	3 623	27	1 504	234	150	4	13	810	14	1 490	3 077	1 282
1971	30 924	22 096	488	8 340	106	28	15 209	4 551	27	2 173	277	211	—	13	1 010	12	1 931	3 923	1 451

Table S10 (continued)

	All subjects				Engineering						Technology		Science							
	All subjects	Engineering	Technology	Science	Chemical engineering	Civil and structural engineering	Electrical engineering	Mechanical engineering	Mining engineering	Other engineering	Metallurgy	Other technologies	Agriculture	Biology	Chemistry	Geology	Mathematics	Physics	General science or other sciences
Electrical engineering																			
1965	9 214	7 560	272	1 382	17	23	4 852	2 271	19	378	178	94	1	1	502	4	139	493	242
1968	8 547	7 104	261	1 182	48	11	4 606	1 746	20	673	155	106	2	5	301	3	161	413	297
1971	9 528	7 895	303	1 330	58	10	4 953	1 999	23	852	179	124	—	5	346	3	188	467	321
Electronics																			
1965	11 834	7 709	97	4 028	6	12	6 286	1 185	5	215	43	54	3	—	379	1	683	2 018	944
1968	16 375	10 744	123	5 508	47	36	7 946	1 877	7	831	79	44	2	8	509	11	1 329	2 664	985
1971	21 396	14 201	185	7 010	50	18	10 256	2 552	4	1 321	98	87	—	8	664	9	1 743	3 456	1 130
Aircraft																			
1965	6 886	5 435	267	1 184	8	28	647	4 160	3	589	196	71	6	1	81	—	500	401	195
1968	7 183	5 687	212	1 284	17	14	528	4 523	1	604	177	35	—	—	112	—	524	368	280
1971	8 693	6 897	245	1 551	24	12	729	5 595	1	535	207	38	—	—	127	—	640	406	378
Motor vehicles																			
1965	2 811	2 415	239	157	5	31	89	2 010	—	280	146	93	16	—	40	3	18	17	63
1968	2 995	2 595	182	218	6	1	82	2 009	2	495	136	46	15	5	39	1	57	24	77
1971	3 953	3 398	241	314	13	2	133	2 507	2	741	174	67	14	5	54	1	116	34	90
Other vehicles																			
1965	1 950	1 815	63	72	—	48	222	1 267	2	276	14	49	—	—	11	—	6	33	22
1968	2 729	2 447	18	264	15	9	247	2 022	—	154	13	5	—	—	37	—	29	151	47
1971	3 025	2 715	22	288	15	5	259	2 258	—	168	17	5	—	—	37	—	46	158	47
Textiles, clothing etc.																			
1965	5 155	942	2 182	2 032	117	32	110	601	12	70	11	2 171	3	5	1 484	1	63	280	196
1968	5 979	1 251	2 411	2 317	144	5	184	750	14	154	8	2 403	3	8	1 595	3	123	380	205
1971	7 173	1 505	3 065	2 603	203	5	202	849	8	238	10	3 055	2	5	1 762	2	149	417	266
Other manufacturing																			
1965	7 707	3 339	1 474	2 894	340	291	451	1 922	42	293	82	1 392	61	35	1 724	36	110	483	445
1968	9 028	4 094	1 707	3 227	293	462	583	2 211	58	487	77	1 630	97	59	1 676	83	183	417	712
1971	11 153	5 231	1 985	3 937	358	591	717	2 758	54	753	84	1 901	117	67	1 994	129	277	513	840

Persons holding degree or equivalent qualifications in engineering, technology and science

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Analysis by research and development and other functions, 1962, 1965, 1968 and forecast 1971

Table S11

	All subjects					Engineering					Technology					Science				
	All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions		All functions	Research and development	Other	Per cent of all functions	
				R & D	Other				R & D	Other				R & D	Other				R & D	Other
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY																				
1962	16 382	2 153	14 229	*13·1*	*86·9*	15 078	1 355	13 723	*9·0*	*91·0*	161	82	99	*38·5*	*61·5*	1 143	736	407	*64·4*	*35·6*
1965	19 180	2 381	16 799	*12·4*	*87·6*	17 333	1 308	16 025	*7·5*	*92·5*	211	151	60	*71·6*	*28·4*	1 638	922	714	*56·4*	*43·6*
1968	22 385	2 750	19 635	*12·3*	*87·7*	19 451	1 587	17 884	*8·2*	*91·8*	369	179	180	*49·9*	*50·1*	2 575	984	1 591	*38·2*	*61·8*
1971	24 539					21 416					374					2 749				
Airweys corporetions																				
1962	219	106	113	*48·4*	*51·6*	157	80	77	*51·0*	*49·0*	43	10	33	*23·3*	*76·7*	18	16	3	*84·2*	*15·8*
1965	308	129	179	*41·9*	*58·1*	206	90	118	*43·7*	*56·3*	25	17	8	*68·0*	*32·0*	77	22	55	*28·6*	*71·4*
1968	560	126	434	*22·6*	*77·5*	450	120	330	*26·7*	*73·3*	10	2	8	*20·0*	*80·0*	100	4	98	*4·0*	*96·0*
1971	692					482					10					100				
Treneport corporations																				
1962	1 974	282	1 712	*13·3*	*86·7*	1 847	157	1 690	*8·6*	*91·5*	21	11	10	*52·4*	*47·6*	108	94	12	*88·7*	*11·3*
1965	2 021	234	1 787	*11·6*	*88·4*	1 828	135	1 693	*7·4*	*92·6*	*27*	9	18	*33·3*	*66·7*	166	90	76	*54·2*	*45·8*
1968	2 091	286	1 806	*13·6*	*86·4*	1 878	165	1 713	*8·8*	*91·2*	22	8	14	*36·4*	*63·6*	191	112	79	*58·6*	*41·4*
1971	2 584					2 303					29					232				
Electricity Council and boards																				
1962	6 879	304	6 576	*4·4*	*95·6*	6 600	188	6 412	*2·8*	*97·2*	56	26	30	*46·4*	*53·6*	223	90	133	*40·4*	*59·6*
1965	9 059	*843*	8 218	*9·3*	*90·7*	8 479	295	8 184	*3·5*	*96·5*	113	111	2	*98·2*	*1·8*	467	437	30	*93·6*	*6·4*
1966	11 571	971	10 600	*8·4*	*91·6*	10 251	418	9 833	*4·1*	*95·9*	223	128	96	*57·4*	*42·6*	1 097	426	672	*38·7*	*61·3*
1871	12 781					11 287					248					1 246				
Gas Council and boards																				
1962	2 266	236	2 030	*10·4*	*89·6*	1 984	125	1 859	*6·3*	*93·7*	26	7	18	*28·0*	*72·0*	267	104	153	*40·5*	*59·5*
1965	2 499	287	2 212	*11·6*	*88·5*	2 144	161	1 993	*7·0*	*93·0*	23	7	16	*30·4*	*69·6*	332	129	203	*38·9*	*61·1*
1968	2 870	363	2 507	*12·6*	*87·4*	2 247	149	2 098	*6·6*	*93·4*	97	34	63	*35·1*	*64·9*	526	180	346	*34·2*	*65·8*
1971	3 244					2 617					82					545				
Ganaral Post Office																				
1962	1 349	750	599	*55·6*	*44·4*	1 233	642	591	*52·1*	*47·9*	8	6	—	*100·0*	—	108	100	*8*	*92·6*	*7·4*
1965	1 431	546	886	*38·2*	*61·8*	1 247	423	824	*33·9*	*66·1*	16	7	9	*43·8*	*56·2*	168	116	52	*69·0*	*31·0*
1968	1 463	535	928	*36·6*	*63·4*	1 300	418	882	*32·2*	*67·8*	—	—	—	—	—	163	117	46	*71·8*	*28·2*
1971	1 762					1 567					—					195				

Table S11 (continued)

	All subjects					Engineering					Technology					Science				
	All functions	Research and development	Other	*Per cent of all functions*		All functions	Research and development	Other	*Per cent of all functions*		All functions	Research and development	Other	*Per cent of all functions*		All functions	Research and development	Other	*Per cent of all functions*	
				R & D	*Other*				*R & D*	*Other*				*R & D*	*Other*				*R & D*	*Other*
National Coal Board																				
1962	3 048	464	2 584	*15·2*	*84·8*	2 661	138	2 523	*5·2*	*94·8*	—	—	—	—	—	387	325	81	*84·2*	*15·8*
1965	3 058	261	2 797	*8·5*	*91·5*	2 658	153	2 505	*5·8*	*94·2*	7	—	7	—	*100·0*	393	108	285	*27·5*	*72·5*
1968	3 059	327	2 732	*10·7*	*89·3*	2 595	189	2 406	*7·3*	*92·7*	7	7	—	*100·0*	—	457	131	326	*28·7*	*71·3*
1971	2 820					2 425					5					390				
Broadcasting																				
1962	647	31	815	*4·8*	*95·2*	596	25	571	*4·2*	*95·8*	8	—	8	—	*100·0*	43	6	37	*14·0*	*86·0*
1965	804	81	723	*10·1*	*89·9*	771	61	710	*7·9*	*92·1*	—	—	—	—	—	33	20	13	*60·6*	*39·4*
1968	771	143	628	*18·5*	*81·5*	730	128	602	*17·5*	*82·5*	—	—	—	—	—	41	15	26	*36·6*	*63·4*
1971	776					735										41				

Persons holding degree or equivalent qualifications in engineering, technology and science

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Change in numbers employed between 1962 and 1965, 1965 and 1968, and forecast 1968 to 1971

Table S12

	1962 to 1965			1965 to 1968			Forecast 1968 to 1971		
	Number in 1962	Change between 1962 and 1965	*Change as a per cent of 1962*	Number in 1965	Change between 1965 and 1968	*Change as a per cent of 1965*	Number in 1988	Forecast change between 1968 and 1971	*Change as a per cent of 1968*
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY									
All subjects	18 382	2 798	*17·1*	19 180	3 205	*16·7*	22 385	2 154	*9·6*
Engineering	15 078	2 256	*15·0*	17 333	2 118	*12·2*	19 451	1 965	*10·1*
Technology	161	50	*31·1*	211	148	*70·1*	359	15	*4·2*
Science	1 143	493	*43·1*	1 636	939	*57·4*	2 675	174	*6·8*
Airways corporations									
All subjects	219	89	*40 6*	308	252	*81·8*	560	32	*5·7*
Engineering	157	49	*31·2*	206	244	*118·4*	450	32	*7·1*
Technology	43	−18	*−41·9*	25	−15	*−60·0*	10	—	—
Science	19	58	*305·3*	77	23	*29·9*	100	—	—
Transport corporations									
All subjects	1 974	47	*2·4*	2 021	70	*3·5*	2 091	473	*22·6*
Engineering	1 847	−19	*−1·0*	1 828	50	*2·7*	1 878	425	*22·6*
Technology	21	6	*28 6*	27	−5	*−18·5*	22	7	*31·8*
Science	106	*60*	*56·6*	166	26	*15·1*	191	41	*21·5*
Electricity Council and boards									
All subjects	6 879	2 180	*31·7*	9 059	2 512	*27·7*	11 571	1 210	*10·5*
Engineering	6 600	1 879	*28·5*	8 479	1 772	*20·9*	10 251	1 036	*10·1*
Technology	56	57	*101·8*	113	110	*97·3*	223	25	*11·2*
Science	223	244	*109·4*	467	630	*134·9*	1 097	149	*13·6*
Gas Council and boards									
All subjects	2 268	233	*10·3*	2 499	371	*14·8*	2 870	374	*13·0*
Engineering	1 964	160	*8·1*	2 144	103	*4·8*	2 247	370	*16·5*
Technology	25	−2	*−8·0*	23	74	*321·7*	97	−15	*−15·5*
Science	257	75	*29·2*	332	194	*58·4*	526	19	*3·6*
General Post Office									
All subjects	1 349	82	*6·1*	1 431	32	*2·2*	1 463	299	*20·4*
Engineering	1 233	14	*1·1*	1 247	53	*4·3*	1 300	267	*20·5*
Technology	8	8	*100·0*	16	−16	*−100·0*	—	—	—
Science	108	60	*55·6*	168	−5	*−3·0*	163	32	*19·6*
National Coal Board									
All subjects	3 048	10	*0·3*	3 058	1	—	3 059	−239	*−7·8*
Engineering	2 661	−3	*0·1*	2 658	−83	*−2·4*	2 595	−170	*−6·6*
Technology	—	7	—	7	—	—	7	−2	*−28·6*
Science	387	6	*1·6*	393	64	*16·3*	467	−67	*−14·7*
Broadcasting									
All subjects	647	157	*24·3*	804	−33	*−4·1*	771	5	*0·6*
Engineering	596	175	*29·4*	771	−41	*−5·3*	730	5	*0·7*
Technology	8	−8	*−100·0*	—	—	—	—	—	—
Science	43	*−10*	*−23·3*	33	8	*24·2*	41	—	—

Parsons holding degree or aquivalent qualifications in anginaaring, technology and science

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Vacancies raportad by employers at January 1965 and January 1968

Tabla S13

	1965			1968		
	QSEs employed	Vacancies	*Vacancies as a per cent of QSEs employed*	QSEs employed	Vacancies	*Vacancies as a per cent of QSEs employed*
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY						
All subjects	19 180	995	*5·2*	22 385	1 336	*6·0*
Engineering	17 333	913	*5·3*	19 451	1 149	*5·9*
Technology	211	1	*0·5*	359	15	*4·2*
Science	1 636	81	*5·0*	2 575	172	*6·7*
Airways corporations						
All subjects	308	2	*0·6*	560	13	*2·3*
Engineering	206	1	*0·5*	450	13	*2·9*
Technology	25	—	—	10	—	—
Science	77	1	*1·3*	100	—	—
Transport corporations						
All subjects	2 021	229	*11·3*	2 091	376	*18·0*
Engineering	1 828	194	*10·6*	1 878	341	*18·2*
Technology	27	1	*3·7*	22	2	*9·1*
Science	156	34	*20·5*	191	33	*17·3*
Electricity Council and boards						
All subjects	9 059	533	*5·9*	11 571	592	*5·1*
Engineering	8 479	533	*6·3*	10 251	509	*5·0*
Technology	113	—	—	223	12	*5·4*
Science	467	—	—	1 097	71	*6·5*
Gas Council and boards						
All subjects	2 499	73	*2·9*	2 870	140	*4·9*
Engineering	2 144	62	*2·9*	2 247	106	*4·7*
Technology	23	—	—	97	1	*1·0*
Science	332	11	*3·3*	526	33	*6·3*
General Post Office						
All subjects	1 431	64	*4·5*	1 463	155	*10·6*
Engineering	1 247	54	*4·3*	1 300	140	*10·8*
Technology	16	—	—	—	—	—
Science	168	10	*6·0*	163	15	*9·2*
National Coal Board						
All subjects	3 058	90	*2·9*	3 059	60	*2·0*
Engineering	2 658	65	*2·4*	2 595	40	*1·5*
Technology	7	—	—	7	—	—
Science	393	25	*6·4*	457	20	*4·4*
Broadcasting						
All subjects	804	4	*0·5*	771	—	—
Engineering	771	4	*0·5*	730	—	—
Technology	—	—	—	—	—	—
Science	33	—	—	41	—	—

Persons holding degree or equivalent qualifications in engineering, technology and science

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Number of QSEs employed as a percentage of all employees (density) in 1962, 1965 and 1968

Table S14

	1962		1965		1968	
	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY						
Total employees	2 117 000		2 007 000		1 807 000	
QSEs	15 382	*0·77*	19 180	*0·96*	22 385	*1·24*
All subjects	16 078	*0·71*	17 333	*0·86*	19 451	*1·08*
Engineering	161	*0·008*	211	*0·01*	359	*0·02*
Technology	1 143	*0·05*	1 636	*0·08*	2 575	*0·14*
Science						
Airways corporations						
Total employees	29 000		29 000		39 000	
QSEs	219	*0·76*	308	*1·06*	580	*1·44*
All subjects	167	*0·54*	206	*0·71*	450	*1·15*
Engineering	43	*0·15*	25	*0·09*	10	*0·03*
Technology	19	*0·07*	77	*0·27*	100	*0·26*
Science						
Transport corporations						
Total employees	699 000		623 000		502 000	
QSEs	1 974	*0·28*	2 021	*0·32*	2 091	*0·42*
All subjects	1 847	*0·26*	1 828	*0·29*	1 878	*0·37*
Engineering	21	*0·003*	27	*0·004*	22	*0·004*
Technology	106	*0·02*	166	*0·03*	191	*0·04*
Science						
Electricity Council and boards						
Total employees	214 000		238 000		244 000	
QSEs	6 879	*3·21*	9 059	*3·84*	11 571	*4·74*
All subjects	6 600	*3·08*	8 479	*3·59*	10 251	*4·20*
Engineering	56	*0·03*	113	*0·05*	223	*0·09*
Technology	223	*0·10*	467	*0·20*	1 097	*0·45*
Science						
Gas Council and boards						
Total employees	124 000		122 000		123 000	
QSEs	2 266	*1·83*	2 499	*2·05*	2 870	*2·33*
All subjects	1 984	*1·60*	2 144	*1·76*	2 247	*1·83*
Engineering	25	*0·02*	23	*0·02*	97	*0·08*
Technology	257	*0·21*	332	*0·27*	526	*0·43*
Science						

Table S14 (continued)

	1962		1965		1868	
	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*	Number employed	*Number employed as per cent of total employees*
General Post Office						
Total employees	377 000		395 000		411 000	
QSEs						
All subjects	1 349	*0·36*	1 431	*0·36*	1 463	*0·36*
Engineering	1 233	*0·33*	1 247	*0·32*	1 300	*0·32*
Technology	8	*0·002*	16	*0·004*	—	—
Science	108	*0·03*	168	*0·04*	163	*0·04*
National Coal Board						
Total employees	656 000		579 000		464 000	
QSEs						
All subjects	3 048	*0·46*	3 058	*0·53*	3 059	*0·66*
Engineering	2 651	*0·41*	2 658	*0·46*	2 595	*0·56*
Technology	—	—	7	*0·001*	7	*0·002*
Science	387	*0·06*	393	*0·07*	457	*0·10*
Broadcasting						
Total employees	18 000		23 000		24 000	
QSEs						
All subjects	647	*3·59*	804	*3·50*	771	*3·21*
Engineering	596	*3·31*	771	*3·35*	730	*3·04*
Technology	8	*0·04*	—	—	—	—
Science	43	*0·24*	33	*0·14*	41	*0·17*

Persons holding degree or equivalent qualifications in engineering, technology and science

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Analysis by subject of qualification held; 1965, 1968 and forecast 1971

Table S15	All subjects				Engineering						Technology		Science						
	All subjects	Engineering	Technology	Science	Chemical engineering	Civil and structural engineering	Electrical engineering	Mechanical engineering	Mining engineering	Other engineering	Metallurgy	Other technologies	Agriculture	Biology	Chemistry	Geology	Mathematics	Physics	General science or other sciences
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY																			
1965	19 180	17 333	211	1 636	2 045	1 258	8 631	2 861	1 779	759	144	67	9	18	654	55	256	449	195
1968	22 385	19 451	359	2 575	1 981	1 191	10 142	3 852	1 692	593	207	152	17	23	1 010	69	377	656	423
1971	24 539	21 416	374	2 749	2 351	1 673	11 048	4 293	1 569	562	222	152	15	20	1 057	54	421	565	517
Airways corporations																			
1965	308	206	25	77	—	3	37	136	1	29	3	22	4	2	2	1	40	10	18
1968	560	450	10	100	3	49	87	271	—	40	8	2	5	3	10	3	48	13	16
1971	592	482	10	100	3	72	90	277	—	40	8	2	5	3	10	3	48	13	18
Transport corporations																			
1965	2 021	1 628	27	166	—	747	321	718	8	34	16	11	—	2	75	3	33	20	33
1968	2 091	1 876	22	191	10	702	370	665	7	104	13	9	—	3	42	4	55	32	55
1971	2 564	2 303	29	232	12	1 021	425	730	7	108	14	15	—	1	67	1	66	36	61
Electricity Council and boards																			
1965	9 059	8 479	113	467	86	330	6 033	1 419	2	607	109	4	5	10	147	—	97	177	31
1968	11 571	10 251	223	1 097	48	281	7 381	2 201	9	351	148	75	11	14	432	3	131	319	167
1971	12 781	11 267	248	1 246	56	290	8 013	2 571	8	349	166	82	10	15	509	2	155	360	195
Gas Council and boards																			
1965	2 499	2 144	23	332	1 906	54	37	125	2	20	4	19	—	1	222	3	23	34	49
1968	2 870	2 247	87	526	1 827	76	50	228	6	60	31	66	1	3	313	6	67	82	64
1971	3 244	2 617	82	545	2 160	65	47	298	4	43	29	53	—	1	295	3	79	54	113
General Post Office																			
1965	1 431	1 247	16	168	—	—	1 214	20	—	13	12	4	—	—	22	—	14	79	63
1968	1 463	1 300	—	163	—	—	1 246	32	—	22	—	—	—	—	21	—	6	32	105
1971	1 762	1 667	—	195	—	—	1 503	38	—	26	—	—	—	—	25	—	6	38	126
National Coal Board																			
1965	3 056	2 656	7	393	51	118	245	422	1 766	56	—	7	—	—	183	48	48	114	—
1968	3 058	2 595	7	457	93	98	293	431	1 670	10	7	—	—	—	191	53	69	144	—
1971	2 820	2 425	5	390	120	120	250	375	1 550	10	5	—	—	—	160	45	86	130	—
Broadcasting																			
1965	804	771	—	33	—	8	744	21	—	—	—	—	—	3	3	—	1	15	11
1968	771	730	—	41	—	5	715	4	—	6	—	—	—	—	1	—	2	34	4
1971	776	735	—	41	—	5	720	4	—	8	—	—	—	—	1	—	2	34	4

Persons working as technicians or technicel supporting staff

ALL FIELDS OF EMPLOYMENT IN SURVEY

Persons working as, and vacancies for, technicians in 1965, 1968 and forecast 1971: analysis by qualification held

Table S15

	Total technicians		Degree		HND or HNC		OND or ONC		Technician's certificate		Other						Vacancies for technicians	
											Total		Beyond 'O' level		Other		Number	*Per cent of total technicians*
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL FIELDS OF EMPLOYMENT IN SURVEY (excluding schools and further education establishments)																		
1965	621 923	*100·0*	23 796	*3·8*	83 139	*13·4*	85 190	*13·7*	57 823*	*9·3*	371 975	*59·8*	..	..	..	..	29 273	*4·7*
1968	720 617	*100·0*	43 088	*6·0*	92 835	*12·9*	82 844	*11·5*	51 956†	*7·2*	449 894	*62·4*	75 865	*10·5*	374 029	*51·9*	24 767	*3·4*
1971	792 234																	
INDUSTRY																		
Manufacturing																		
1965	398 374	*100·0*	14 011	*3·5*	56 081	*14·1*	61 019	*15·3*	37 495	*9·4*	229 768	*57·7*	..	..	..	..	17 419	*4·4*
1968	453 823	*100·0*	26 802	*5·9*	59 507	*13·1*	56 810	*12·5*	31 143	*6·9*	279 561	*61·6*	39 032	*8·6*	240 529	*53·0*	11 993	*2·6*
1971	503 046																	
Construction																		
1965	48 383	*100·0*	831	*1·8*	5 751	*12·4*	6 509	*14·0*	5 242	*11·3*	28 050	*60·5*	..	..	..	..	2 207	*4·8*
1968	61 433	*100·0*	2 967	*4·8*	9 627	*15·7*	7 264	*11·8*	3 642	*5·9*	37 933	*61·8*	5 442	*8·9*	32 491	*52·9*	1 241	*2·0*
1971	70 238																	
Industrial research associations[1]																		
1965	2 703	*100·0*	71	*2·6*	539	*19·9*	375	*13·9*	181	*6·7*	1 537	*56·9*	..	..	..	..	245	*9·1*
1968	2 937	*100·0*	126	*4·3*	440	*15·0*	275	*9·4*	289	*9·8*	1 807	*61·5*	330	*11·2*	1 477	*50·3*	120	*4·1*
1971	3 302																	
NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS																		
1965	72 486	*100·0*	2 477	*3·4*	11 750	*16·2*	7 093	*9·8*	4 235	*5·8*	46 931	*64·8*	..	..	..	..	3 897	*5·4*
1968	83 823	*100·0*	6 275	*7·5*	10 645	*12·7*	6 753	*8·0*	6 347	*7·6*	53 803	*64·2*	16 228	*19·4*	37 575	*44·8*	5 503	*6·6*
1971	89 633																	
GOVERNMENT																		
Total																		
1965	89 413	*100·0*	5 942	*6·7*	8 350	*9·3*	9 418	*10·5*	8 394	*9·4*	57 309	*64·1*	..	..	..	..	4 637	*5·2*
1968	101 532	*100·0*	6 149	*6·1*	11 641	*11·5*	10 610	*10·4*	8 263	*8·1*	64 869	*63·9*	11 927	*11·8*	52 942	*52·1*	4 967	*4·9*
1971	105 973																	

* Technician's certificate of the City and Guilds or a similar nationally recognised qualification.

† Full Technological Certificate or a Technician's Certificate of the City and Guilds Institute. See line 23 of questionnaire on page 115.

Table S16 (continued)

	Total technicians		Degree		HND or HNC		OND or ONC		Technician's certificate		Other						Vacancies for technicians	
											Total		Beyond 'O' level		Other		Number	*Per cent of total technicians*
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
Government departments[1]																		
1965	57 965	*100·0*	3 426	*5·9*	4 882	*8·4*	6 340	*10·9*	5 378	*9·3*	37 939	*65·5*	..	..	..	..	2 149	*3·7*
1968	56 176	*100·0*	3 449	*6·1*	6 870	*12·2*	6 970	*12·4*	4 686	*8·4*	34 201	*60·9*	5 822	*10·4*	28 379	*50·5*	1 740	*3·1*
1971	55 798																	
Research councils[1]																		
1965	3 029	*100·0*	404	*13·3*	161	*5·3*	102	*3·4*	260	*8·6*	2 102	*69·4*	..	..	..	..	219	*7·2*
1968	4 667	*100·0*	714	*15·3*	445	*9·5*	278	*6·0*	340	*7·3*	2 890	*61·9*	685	*14·7*	2 205	*47·2*	376	*8·1*
1971	5 433																	
Atomic Energy Authority																		
1965	7 068	*100·0*	1 188	*16·8*	1 343	*19·0*	1 158	*16·4*	368	*5·2*	3 011	*42·6*	..	..	..	..	141	*2·0*
1968	6 814	*100·0*	1 057	*15·5*	1 366	*20·1*	974	*14·3*	259	*3·8*	3 158	*46·3*	1 037	*15·2*	2 121	*31·1*	88	*1·3*
1971	6 442																	
Local authorities[2]																		
1965	21 351	*100·0*	924	*4·3*	1 964	*9·2*	1 818	*8·5*	2 388	*11·2*	14 267	*66·8*	..	..	..	..	2 128	*10·0*
1968	33 875	*100·0*	929	*2·7*	2 960	*8·7*	2 388	*7·1*	2 978	*8·8*	24 620	*72·7*	4 383	*12·9*	20 237	*59·8*	2 763	*8·1*
1971	38 300																	
EDUCATION[3]																		
Universities[4]																		
1965	12 564	*100·0*	464	*3·7*	868	*5·3*	776	*6·2*	2 276	*18·1*	8 380	*66·7*	..	..	..	..	868	*6·9*
1968	17 069	*100·0*	769	*4·5*	975	*5·7*	1 132	*6·7*	2 272	*13·3*	11 921	*69·8*	2 906	*17·0*	9 015	*52·8*	953	*5·6*
1971	20 042																	

(1) Data for 1965 are not strictly comparable with 1968. See general note.

(2) Including technicians and other technical supporting staff employed in schools and further education establishments maintained by local authorities. Data for 1965 are not strictly comparable with 1968. See also general note.

(3) See footnote (2) above.

(4) Data for 1965 include colleges of advanced technology.

Persons working as technicians or technical supporting staff

ALL FIELDS OF EMPLOYMENT IN SURVEY

Relationship between the number of technicians and the number of persons with qualifications in engineering, technology and science: in all functions

Table S17

	QSEs						Total technicians (Number)	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL FIELDS OF EMPLOYMENT IN SURVEY (excluding schools and further education establishments)								
1965	173 408	*100·0*	23 796	*13·7*	149 612	*86·3*	621 923	4·2
1968	198 499	*100·0*	43 088	*21·7*	155 411	*78·3*	720 817	4·6
INDUSTRY								
Manufacturing								
1965	98 540	*100·0*	14 011	*14·2*	84 529	*85·8*	398 374	4·7
1968	111 276	*100·0*	26 802	*24·1*	84 474	*75·9*	453 823	5·4
Construction								
1965	7 190	*100·0*	831	*11·6*	6 359	*88·4*	46 383	7·3
1968	9 670	*100·0*	2 967	*30·7*	6 703	*69·3*	61 433	9·2
Industrial research associations[1]								
1965	2 230	*100·0*	71	*3·2*	2 159	*96·8*	2 703	1·3
1968	2 175	*100·0*	126	*5·8*	2 049	*94·2*	2 937	1·4
NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS								
1965	19 180	*100·0*	2 477	*12·9*	18 703	*87·1*	72 486	4·3
1968	22 385	*100·0*	6 275	*28·0*	16 110	*72·0*	83 823	5·2
GOVERNMENT								
Total	32 383	*100·0*	5 942	*18·3*	26 441	*81·7*	89 413	3·4
1965	34 321	*100·0*	8 149	*17·9*	28 172	*82·1*	101 532	3·6
1968								
Government departments[1]	15 948	*100·0*	3 426	*21·5*	12 520	*78·5*	57 965	4·6
1965	14 972	*100·0*	3 449	*23·0*	11 523	*77·0*	56 176	4·9
1968								
Research councils[1]	1 756	*100·0*	404	*23·0*	1 352	*77·0*	3 029	2·2
1965	2 939	*100·0*	714	*24·3*	2 225	*75·7*	4 667	2·1
1968								
Atomic Energy Authority	5 031	*100·0*	1 188	*23·6*	3 843	*76·4*	7 068	1·8
1965	4 685	*100·0*	1 057	*22·6*	3 628	*77·4*	6 814	1·9
1968								
Local authorities[2]	9 650	*100·0*	924	*9·6*	8 726	*90·4*	21 351	2·4
1965	11 725	*100·0*	929	*7·9*	10 796	*92·1*	33 876	3·1
1968								
EDUCATION								
Universities[3]								
1965	13 885	*100·0*	464	*3·3*	13 421	*96·7*	12 564	*0·9*
1968	18 672	*100·0*	769	*4·1*	17 903	*95·9*	17 069	1·0

(1) Data for 1965 are not strictly comparable with 1968. See general notes.

(2) Including technicians and other technical supporting staff employed in schools and further education establishments maintained by local authorities. Data for 1965 are not strictly comparable with 1968. See general notes.

(3) 1965 data include colleges of advanced technology.

Persons working as technicians or technical supporting staff

ALL FIELDS OF EMPLOYMENT IN SURVEY

Relationship between the number of technicians and the number of persons holding degree or equivalent qualifications in engineering, technology and science: in research and development

Table S18

	QSEs						Total technicians (Number)	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL FIELDS OF EMPLOYMENT IN SURVEY (excluding education)								
1965	53 869	*100·0*	8 706	*16·2*	45 164	*83·8*	97 348	2·2
1968	58 571	*100·0*	12 983	*22·9*	43 588	*77·1*	106 426	2·4
INDUSTRY								
Manufacturing								
1965	37 124	*100·0*	4 879	*13·1*	32 245	*86·9*	70 988	2·2
1968	38 914	*100·0*	8 650	*22·2*	30 254	*77·8*	77 540	2·8
Construction								
1965	281	*100·0*	42	*14·9*	239	*85·1*	387	1·6
1968	417	*100·0*	79	*18·9*	338	*81·1*	661	2·0
Industrial research associations[1]								
1965	2 003	*100·0*	46	*2·3*	1 957	*97·7*	2 171	1·1
1968	1 973	*100·0*	114	*5·8*	1 859	*94·2*	2 519	1·4
NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS								
1965	2 381	*100·0*	488	*20·5*	1 893	*79·5*	3 329	1·8
1968	2 750	*100·0*	478	*17·4*	2 272	*82·6*	3 631	1·6
GOVERNMENT								
Total								
1965	12 080	*100·0*	3 250	*26·9*	8 830	*73·1*	20 475	2·3
1968	12 517	*100·0*	3 682	*29·3*	8 856	*70·7*	22 075	2·5
Government departments[1]								
1965	8 917	*100·0*	1 929	*27·9*	4 988	*72·1*	13 254	2·7
1968	6 345	*100·0*	2 129	*33·6*	4·216	*66·4*	13 480	3·2
Research councils[1]								
1965	1 747	*100·0*	404	*23·1*	1 343	*76·9*	2 989	2·2
1968	2 750	*100·0*	713	*25·9*	2 037	*74·1*	4 141	2·0
Atomic Energy Authority								
1965	3 168	*100·0*	881	*27·8*	2 287	*72·2*	3 960	1·7
1968	3 037	*100·0*	787	*25·9*	2 250	*74·1*	3 921	1·7
Local authorities[2]								
1965	248	*100·0*	36	*14·5*	212	*85·5*	272	1·3
1968	385	*100·0*	33	*8·6*	352	*91·4*	533	1·5

(1) Data for 1965 are not strictly comparable with 1968. See general notes.

(2) Including technicians and other technical supporting staff employed in schools and further education establishments maintained by local authorities. Data for 1965 are not strictly comparable with 1968. See general notes.

Persons working as technicians or technical supporting staff

ALL FIELDS OF EMPLOYMENT IN SURVEY

Relationship between the number of technicians and the number of persons holding degree or equivalent qualifications in engineering, technology and science: in functions other than research and development

Table S19

	QSEs						Total technicians (Number)	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL FIELDS OF EMPLOYMENT IN SURVEY (excluding education)								
1965	105 654	*100·0*	14 627	*13·8*	91 027	*86·2*	512 011	6·6
1968	123 256	*100·0*	29 336	*23·8*	93 920	*76·2*	597 122	6·4
INDUSTRY								
Manufacturing								
1965	81 416	*100·0*	9 132	*14·9*	52 284	*85·1*	327 388	6·3
1968	72 382	*100·0*	18 152	*25·1*	54 210	*74·9*	376 283	6·9
Construction								
1965	6 909	*100·0*	789	*11·4*	6 120	*88·6*	45 996	7·5
1968	9 253	*100·0*	2 888	*31·2*	6 365	*68·8*	60 772	9·6
Industrial research associations[1]								
1965	227	*100·0*	25	*11·0*	202	*89·0*	532	2·8
1968	202	*100·0*	12	*5·9*	190	*94·1*	418	2·2
NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS								
1965	16 799	*100·0*	1 989	*11·8*	14 810	*88·2*	69 157	4·7
1968	19 635	*100·0*	5 797	*29·5*	13 838	*70·5*	80 192	5·8
GOVERNMENT								
Total								
1965	20 303	*100·0*	2 692	*13·3*	17 611	*86·7*	68 938	3·9
1968	21 804	*100·0*	2 487	*11·4*	19 317	*88·6*	79 457	4·1
Government departments[1]								
1965	9 029	*100·0*	1 497	*16·6*	7 632	*83·4*	44 711	5·9
1968	8 627	*100·0*	1 320	*15·3*	7 307	*84·7*	42 696	6·8
Research councils[1]								
1965	9	*100·0*	—	—	9	*100·0*	40	4·4
1968	189	*100·0*	1	*0·5*	188	*99·5*	526	2·8
Atomic Energy Authority								
1965	1 863	*100·0*	307	*16·5*	1 556	*83·5*	3 108	2·0
1968	1 648	*100·0*	270	*16·4*	1 378	*83·6*	2 893	2·1
Local authorities[2]								
1965	9 402	*100·0*	888	*9·4*	8 614	*90·6*	21 079	2·5
1968	11 340	*100·0*	896	*7·9*	10 444	*92·1*	33 342	3·2

(1) Data for 1965 are not strictly comparable with 1968. See general notes.

(2) Including technicians and other technical supporting staff employed in schools and further education establishments maintained by local authorities. Data for 1965 are not strictly comparable with 1968. See general notes.

MANUFACTURING IN SURVEY

Persons working as and vacancies for technicians in 1965, 1968 and forecast 1971: analysis by qualifications held

Table S20

	Total technicians		Degree		HND or HNC		OND or ONC		Technician's certificate		Other						Vacancies for technicians	
											Total		Beyond 'O' level		Other		Number	Per cent of total technicians
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent		
ALL MANUFACTURING IN SURVEY																		
1965	398 374	100·0	14 011	3·5	56 081	14·1	81 019	15·3	37 495	9·4	229 768	57·7	..	..	..	..	17 419	4·4
1968	453 823	100·0	26 802	5·9	59 507	13·1	56 810	12·5	31 143	6·9	279 561	61·6	39 032	8·6	240 629	53·0	11 993	2·6
1971	503 048																	
Food, drink and tobacco																		
1965	12 724	100·0	811	6·4	1 214	9·5	1 251	9·8	1 820	14·3	7 628	60·0	..	..	..	..	356	2·8
1968	18 308	100·0	890	4·9	1 420	7·7	1 274	7·0	1 495	8·2	13 229	72·2	1 857	10·1	11 372	62·1	332	1·8
1971	19 916																	
Chemicals and allied industries (excluding mineral oil refining)																		
1965	31 030	100·0	2 188	7·0	4 973	15·0	5 614	18·1	2 680	8·6	15 597	50·3	..	..	..	..	1 243	4·0
1968	38 206	100·0	3 313	8·7	6 298	16·5	4 959	13·0	1 657	4·3	21 978	57·5	4 324	11·3	17 654	46·2	1 116	2·9
1971	39 902																	
Mineral oil refining																		
1965	2 719	100·0	175	6·4	633	23·3	323	11·9	162	6·0	1 426	52·4	..	..	..	..	101	3·7
1968	2 318	100·0	106	4·6	437	18·8	294	12·7	114	4·9	1 367	59·0	165	7·1	1 202	51·9	23	1·0
1971	2 049																	
Metal menufecture																		
1966	27 138	100·0	941	3·5	4 384	16·2	3 767	13·8	1 542	5·7	16 514	60·8	..	..	..	..	896	3·3
1968	25 771	100·0	1 689	6·5	4 222	16·4	3 200	12·4	1 640	6·4	15 020	58·3	1 384	5·4	13 636	52·9	407	1·6
1971	27 411																	
Mechanicel engineering																		
1965	117 549	100·0	3 003	2·5	16 666	14·2	20 290	17·3	9 995	8·5	67 596	57·5	..	..	..	..	5 421	4·5
1968	134 547	100·0	8 404	6·3	18 621	13·8	19 331	14·4	8 883	6·5	79 308	58·9	10 013	7·4	69 295	51·5	2 932	2·2
1971	150 330																	
Electricel engineering and electronics																		
1965	76 107	100·0	2 977	3·9	12 449	16·4	13 628	17·9	7 150	9·4	39 905	52·4	..	..	..	..	3 957	5·2
1968	86 569	100·0	4 784	5·5	12 656	14·6	12 356	14·3	5 577	6·4	51 196	59·2	7 614	8·7	43 682	50·5	3 425	4·0
1971	100 519																	

Table S20 (continued)

	Total technicians		Degree		HND or HNC		ONO or ONC		Technician's certificate		Other						Vacancies for technicians	
											Total		Beyond 'O' level		Other		Number	*Per cent of total technicians*
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
Electrical engineering																		
1965	35 946	*100·0*	1 306	*3·6*	6 371	*17·7*	7 297	*20·3*	2 687	*7·5*	18 285	*50·9*	..	..	..	..	1 770	*4·9*
1968	36 872	*100·0*	1 870	*5·1*	6 132	*16·6*	6 092	*16·5*	2 208	*6·0*	20 570	*55·8*	2 717	*7·4*	17 853	*48·4*	538	*1·5*
1971	39 235																	
Electronics																		
1965	40 161	*100·0*	1 671	*4·2*	6 078	*15·1*	6 329	*15·8*	4 463	*11·1*	21 620	*53·8*	..	..	..	..	2 187	*5·4*
1968	49 697	*100·0*	2 914	*5·9*	6 524	*13·1*	6 284	*12·6*	3 369	*6·8*	30 626	*61·6*	4 797	*9·6*	25 829	*52·0*	2 887	*5·8*
1971	61 284																	
Aircraft																		
1965	41 257	*100·0*	1 254	*3·1*	5 709	*13·8*	5 075	*12·3*	2 431	*5·9*	26 788	*64·9*	..	..	..	..	1 421	*3·4*
1968	37 731	*100·0*	1 864	*6·0*	5 517	*14·6*	4 986	*13·2*	1 477	*3·9*	23 887	*63·3*	5 388	*14·3*	18 499	*49·0*	932	*2·5*
1971	41 322																	
Motor vehicles																		
1965	18 053	*100·0*	557	*3·1*	2 968	*16·4*	3 577	*19·8*	2 131	*11·8*	8 820	*48·9*	..	..	..	..	760	*4·2*
1968	19 846	*100·0*	1 021	*5·1*	2 528	*12·7*	3 150	*15·9*	1 788	*9·0*	11 359	*57·3*	1 442	*7·3*	9 917	*50·0*	794	*4·0*
1971	22 889																	
Other vehicles																		
1965	8 257	*100·0*	448	*5·4*	1 458	*17·7*	1 778	*21·5*	410	*5·0*	4 163	*50·4*	..	..	..	..	605	*7·3*
1968	11 184	*100·0*	623	*5·6*	1 919	*17·1*	1 766	*15·8*	491	*4·4*	6 385	*57·1*	611	*5·5*	5 774	*51·6*	366	*3·3*
1971	11 346																	
Textiles, clothing, etc.																		
1965	27 741	*100·0*	537	*1·9*	1 540	*5·6*	1 942	*7·0*	4 684	*16·9*	19 038	*68·6*	..	..	..	..	819	*3·0*
1968	31 581	*100·0*	1 689	*5·3*	1 759	*5·6*	1 680	*5·3*	3 511	*11·1*	22 942	*72·7*	2 136	*6·8*	20 806	*65·9*	636	*2·0*
1971	34 004																	
Other manufacturing																		
1965	35 799	*100·0*	1 142	*3·2*	4 088	*11·4*	3 786	*10·6*	4 490	*12·5*	22 293	*62·3*	..	..	..	..	1 841	*5·1*
1968	47 763	*100·0*	2 419	*5·1*	4 130	*8·6*	3 814	*8·0*	4 510	*9·4*	32 890	*68·9*	4 198	*8·8*	28 692	*60·1*	1 031	*2·2*
1971	53 359																	

MANUFACTURING IN SURVEY

Relationship between the number of technicians and the number of persons holding degree or equivalent qualifications in engineering, technology and science: in all functions

Table S21

	QSEs						Total technicians (Number)	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL MANUFACTURING IN SURVEY								
1965	98 540	*100·0*	14 011	*14·2*	84 529	*85·8*	398 374	4·7
1968	111 276	*100·0*	26 802	*24·1*	84 474	*75·9*	453 823	5·4
Food, drink and tobacco								
1965	4 584	*100·0*	811	*17·7*	3 773	*82·3*	12 724	3·4
1968	5 114	*100·0*	890	*17·4*	4 224	*82·6*	18 308	4·3
Chemicals and allied industries (excluding mineral oil refining)								
1965	17 415	*100·0*	2 166	*12·4*	15 249	*87·6*	31 030	2·0
1968	19 920	*100·0*	3 313	*16·6*	16 607	*83·4*	38 205	2·3
Mineral oil refining								
1965	2 492	*100·0*	175	*7·0*	2 317	*93·0*	2 719	1·2
1968	2 524	*100·0*	106	*4·2*	2 418	*95·8*	2 318	1·0
Metal manufacture								
1965	7 213	*100·0*	941	*13·0*	6 272	*87·0*	27 138	4·3
1968	7 547	*100·0*	1 689	*22·4*	5 858	*77·6*	25 771	4·4
Mechanical engineering								
1965	21 278	*100·0*	3 003	*14·1*	18 275	*85·9*	117 549	6·4
1968	23 335	*100·0*	8 404	*36·0*	14 931	*64·0*	134 547	9·0
Electrical engineering and electronics								
1965	21 048	*100·0*	2 977	*14·1*	18 071	*85·9*	76 107	4·2
1968	24 922	*100·0*	4 784	*19·2*	20 138	*80·8*	86 569	4·3
Electrical engineering								
1965	9 214	*100·0*	1 306	*14·2*	7 908	*85·8*	35 946	4·5
1968	8 547	*100·0*	1 870	*21·9*	6 677	*78·1*	36 872	5·5
Electronics								
1965	11 834	*100·0*	1 671	*14·1*	10 163	*85·9*	40 161	4·0
1968	16 375	*100·0*	2 914	*17·8*	13 461	*82·2*	49 697	3·7
Aircraft								
1965	8 886	*100·0*	1 254	*18·2*	5 632	*81·8*	41 257	7·3
1968	7 183	*100·0*	1 864	*26·0*	5 319	*74·0*	37 731	7·1
Motor vehicles								
1965	2 811	*100·0*	557	*19·8*	2 254	*80·2*	18 053	8·0
1968	2 995	*100·0*	1 021	*34·1*	1 974	*65·9*	19 846	10·1
Other vehicles								
1965	1 950	*100·0*	448	*23·0*	1 502	*77·0*	8 257	5·5
1968	2 729	*100·0*	823	*22·8*	2 108	*77·2*	11 184	5·3
Textiles, clothing, etc.								
1965	5 158	*100·0*	537	*10·4*	4 619	*89·6*	27 741	6·0
1968	5 979	*100·0*	1 689	*28·2*	4 290	*71·8*	31 581	7·4
Other manufacturing								
1965	7 707	*100·0*	1 142	*14·8*	8 565	*85·2*	35 799	5·5
1968	9 028	*100·0*	2 419	*26·8*	6 609	*73·2*	47 763	7·2

Parsons working as technicians or technical supporting staff

MANUFACTURING IN SURVEY

Relationship between the number of techniciens and the number of persons holding degree or equivelent quelificatione in engineering, technology and science: in reseerch end development

Tabla S22

	QSEs						Total technicians (Number)	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL MANUFACTURING IN SURVEY								
1965	37 124	*100·0*	4 879	*13·1*	32 245	*86·9*	70 986	2·2
1968	38 914	*100·0*	8 650	*22·2*	30 264	*77·8*	77 540	2·6
Food, drink and tobacco								
1965	1 309	*100·0*	164	*12·5*	1 145	*87·5*	1 908	1·7
1968	1 373	*100·0*	152	*11·1*	1 221	*88·9*	2 162	1·8
Chamicals end allied industries (excluding mineral oil refining)								
1965	7 195	*100·0*	867	*12·1*	6 328	*87·9*	10 450	1·7
1968	8 677	*100·0*	1 560	*18·0*	7 117	*82·0*	14 339	2·0
Mineral oil rafining								
1966	1 104	*100·0*	54	*4·9*	1 050	*95·1*	983	0·9
1968	868	*100·0*	31	*3·6*	837	*96·4*	836	1·0
Metal manufacture								
1965	2 172	*100·0*	207	*9·5*	1 965	*90·5*	3 372	1·7
1968	1 755	*100·0*	370	*21·1*	1 385	*78·9*	2 955	2·1
Mechanical engineering								
1965	6 176	*100·0*	535	*10·3*	4 641	*89·7*	11 170	2·4
1968	5 063	*100·0*	1 583	*31·3*	3 480	*68·7*	12 949	3 7
Electrical engineering and electronics								
1965	10 621	*100·0*	1 104	*10·4*	9 517	*89·6*	18 818	2·0
1988	10 540	*100·0*	1 786	*16·9*	8 754	*83·1*	17 382	2·0
Electrical engineering								
1965	3 485	*100·0*	452	*13·0*	3 033	*87·0*	6 304	2·1
1968	2 460	*100·0*	510	*20·7*	1 950	*79·3*	4 719	2·4
Electronics								
1965	7 136	*100·0*	652	*9·1*	6 484	*90·9*	12 314	1·9
1968	8 080	*100·0*	1 276	*15·8*	6 804	*84·2*	12 663	1·9
Aircraft								
1965	4 192	*100·0*	1 054	*25·1*	3 138	*74·9*	12 964	4·1
1968	4 323	*100·0*	1 080	*25·0*	3 243	*75·0*	13 281	4·1
Motor vehicles								
1965	712	*100·0*	90	*12·6*	622	*87·4*	2 311	3·7
1968	858	*100·0*	304	*35·4*	554	*64·6*	2 684	4·8
Other vehicles								
1965	343	*100·0*	72	*21·0*	271	*79·0*	627	2·3
1968	791	*100·0*	125	*15·8*	666	*84·2*	931	1·4
Textiles, clothing, etc.								
1965	1 498	*100·0*	210	*14·0*	1 288	*86·0*	2 833	2·2
1968	1 726	*100·0*	762	*44·1*	964	*55·9*	3 741	3·9
Other manufacturing								
1965	2 602	*100·0*	522	*18·6*	2 280	*81·4*	5 770	2·5
1968	2 940	*100·0*	897	*30·5*	2 043	*69·5*	6 280	3·1

Persons working as technicians or technical supporting staff

MANUFACTURING IN SURVEY

Relationship between the number of technicians end the number of persons holding degree or equivalent qualificetions in engineering, technology and science: in functions other than research and development

Table S23

	QSEs						Total technicians (Number)	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL MANUFACTURING IN SURVEY								
1965	61 416	*100·0*	9 132	*14·9*	52 284	*85·1*	327 388	6·3
1968	72 362	*100 0*	18 152	*25·1*	54 210	*74 9*	376 283	6·9
Food, drink end tobecco								
1965	3 275	*100·0*	647	*19·8*	2 628	*80·2*	10 816	4·1
1968	3 741	*100·0*	738	*19·7*	3 003	*80·3*	16 146	5·4
Chemicals end ellied industries (excluding mineral oil refining)								
1965	10 220	*100·0*	1 299	*12·7*	8 921	*87·3*	20 580	2·3
1968	11 243	*100·0*	1 753	*15·6*	9 490	*84·4*	23 866	2·5
Mineral oil refining								
1965	1 388	*100·0*	121	*8·7*	1 267	*91·3*	1 756	1·4
1968	1 656	*100·0*	75	*4·5*	1 581	*95·5*	1 482	0·9
Metal manufacture								
1965	5 041	*100·0*	734	*14·6*	4 307	*85·4*	23 766	5 5
1968	5 792	*100·0*	1 319	*22·8*	4 473	*77·2*	22 816	5·1
Mechanical engineering								
1965	16 102	*100·0*	2 468	*15·3*	13 634	*84·7*	106 379	7·8
1968	18 272	*100·0*	6 821	*37·3*	11 451	*62·7*	121 598	10·8
Electrical engineering and electronics								
1965	10 427	*100·0*	1 873	*18·0*	8 554	*82·0*	57 489	6·7
1968	14 382	*100·0*	2 998	*20·8*	11 384	*79·2*	69 187	6·1
Electrical engineering								
1965	5 729	*100·0*	854	*14·9*	4 875	*85·1*	29 642	6·1
1968	6 087	*100·0*	1 360	*22·3*	4 727	*77·7*	32 153	6·8
Electronics								
1965	4 698	*100·0*	1 019	*21·7*	3 879	*78·3*	27 847	7·6
1968	8 295	*100·0*	1 638	*19·7*	8 657	*80·3*	37 034	5·6
Aircreft								
1965	2 694	*100·0*	200	*7·4*	2 494	*92·6*	28 293	11·3
1968	2 860	*100·0*	784	*27·4*	2 076	*72·6*	24 450	11·8
Motor vehicles								
1965	2 099	*100·0*	467	*22·2*	1 632	*77·8*	15 742	9·6
1968	2 137	*100·0*	717	*33·6*	1 420	*66·4*	17 162	12·1
Other vehicles								
1965	1 607	*100·0*	378	*23·4*	1 231	*78·6*	7 630	5·2
1968	1 938	*100·0*	498	*25·7*	1 440	*74·3*	10 253	7·1
Textiles, clothing, etc.								
1965	3 658	*100·0*	327	*8·9*	3 331	*91·1*	24 908	7·5
1968	4 253	*100·0*	927	*21·8*	3 326	*78·2*	27 840	8·4
Other menufacturing								
1965	4 905	*100·0*	620	*12·6*	4 285	*87·4*	30 029	7·0
1968	6 088	*100·0*	1 522	*25·0*	4 566	*75·0*	41 483	9·1

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Parsons working as and vacancies for technicians in 1965, 1968 and forecast 1971 : analysis by qualification held

Table S24

	Total technicians		Degree		HNO or HNC		OND or ONC		Technicians certificate		Other						Vacancies for technicians	
											Total		Beyond 'O' level		Other		Number	*Per cent of total technicians*
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY																		
1965	72 486	*100·0*	2 477	*3·4*	11 750	*16·2*	7 093	*9·8*	4 235	*5·8*	46 931	*64·8*	..	..	..	..	3 897	*5·4*
1968	83 823	*100·0*	6 275	*7·5*	10 645	*12·7*	6 753	*8·0*	6 347	*7·6*	63 803	*64·2*	16 228	*19·4*	37 575	*44·8*	5 503	*6·6*
1971	89 633																	
Airways corporations																		
1965	1 547	*100·0*	157	*10·1*	97	*6·3*	201	*13·0*	91	*5·9*	1 001	*64·7*	..	..	..	..	20	*1·3*
1968	3 484	*100·0*	222	*6·4*	233	*6·7*	361	*10·4*	441	*12·6*	2 227	*63·9*	849	*24·4*	1 378	*39·5*	73	*2·1*
1971	3 614																	
Transport corporations																		
1965	10 515	*100·0*	782	*7·4*	1 302	*12·4*	1 513	*14·4*	395	*3·8*	6 523	*62·0*	..	..	..	..	1 528	*14·5*
1968	13 371	*100·0*	731	*5·5*	1 571	*11·7*	1 322	*9·9*	237	*1·8*	9 610	*71·1*	321	*2·4*	9 189	*68·7*	1 490	*11·1*
1971	14 603																	
Electricity Council and boards																		
1965	17 306	*100·0*	98	*0·6*	8 285	*47·9*	3 156	*18·2*	93	*0·5*	5 674	*32·8*	..	..	..	..	545	*3·1*
1968	17 944	*100·0*	3 667	*20·4*	6 084	*33·8*	2 226	*12·4*	441	*2·5*	5 546	*30·9*	919	*5·1*	4 627	*25·8*	631	*3·5*
1971	18 118																	
Gas Council and boards																		
1965	6 483	*100·0*	474	*7·3*	591	*9·1*	642	*9·9*	1 000	*15·4*	3 776	*58·3*	..	..	..	..	180	*2·8*
1968	9 764	*100·0*	499	*5·1*	957	*9·8*	834	*8·6*	2 159	*22·1*	5 315	*54·4*	667	*6·8*	4 648	*47·6*	369	*3·8*
1971	10 503																	
General Post Office																		
1965	27 392	*100·0*	817	*3·0*	812	*3·0*	1 112	*4·0*	666	*2·4*	23 985	*87·6*	..	..	..	..	1 397	*5·1*
1968	31 602	*100·0*	860	*2·7*	1 279	*4·1*	1 591	*5·0*	1 111	*3·6*	26 761	*84·7*	13 386	*42·4*	13 375	*42·3*	2 783	*8·8*
1971	35 200																	
National Coal Board																		
1965	5 675	*100·0*	143	*2·5*	514	*9·1*	401	*7·1*	1 936	*34·1*	2 681	*47·2*	..	..	..	..	225	*4·0*
1968	5 724	*100·0*	198	*3·5*	457	*8·0*	338	*5·9*	1 930	*33·7*	2 801	*48·9*	—	—	2 801	*48·9*	120	*2·1*
1971	5 600																	
Broadcasting																		
1965	3 568	*100·0*	6	*0·2*	149	*4·2*	68	*1·9*	54	*1·5*	3 291	*92·2*	..	..	..	..	2	*0·1*
1968	1 934	*100·0*	98	*5·1*	84	*4·3*	81	*4·2*	28	*1·4*	1 643	*85·0*	86	*4·5*	1 557	*80·5*	37	*1·9*
1971	1 995																	

Persons working as technicians or technical supporting staff

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Relationship between the number of technicians and the number of persons with qualifications in engineering, technology and science: in all functions

Table S25

	QSEs						Total technicians	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*	(Number)	
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY								
1965	19 180	*100·0*	2 477	*12·9*	16 703	*87·1*	72 486	4·3
1968	22 385	*100·0*	6 275	*28·0*	16 110	*72·0*	83 823	5·2
Airways corporations								
1965	308	*100·0*	157	*51·0*	151	*49·0*	1 547	10·2
1968	560	*100·0*	222	*39·6*	338	*60·4*	3 484	10·3
Transport corporations								
1965	2 021	*100·0*	782	*38·7*	1 239	*61·3*	10 515	8·5
1968	2 091	*100·0*	731	*35·0*	1 360	*65·0*	13 371	9·8
Electricity Council and boards								
1965	9 059	*100·0*	98	*1·1*	8 961	*98·9*	17 306	1·9
1968	11 571	*100·0*	3 687	*31·7*	7 904	*68·3*	17 944	2·3
Gas Council and boards								
1965	2 499	*100·0*	474	*19·0*	2 025	*81·0*	6 483	3·2
1968	2 870	*100·0*	499	*17·4*	2 371	*82·6*	9 764	4·1
Ganaral Post Office								
1965	1 431	*100·0*	817	*57·1*	814	*42·9*	27 392	44·6
1968	1 463	*100·0*	860	*58·8*	603	*41·2*	31 602	52·4
National Coal Board								
1965	3 058	*100·0*	143	*4·7*	2 915	*95·3*	5 675	1·9
1968	3 059	*100·0*	198	*6·5*	2 861	*93·5*	5 724	2·0
Broadcasting								
1965	804	*100·0*	8	*0·7*	798	*99·3*	3 588	4·5
1968	771	*100·0*	98	*12·7*	673	*87·3*	1 934	2·9

Persons working as techniciana or technical supporting staff

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Relationship between the number of technicians and the number of persons holding degree or equivalent qualificetions in engineering, technology end science: in research and development

Table S26

	OSEs						Total technicians (Number)	Number of technicians per OSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY								
1965	2 381	*100·0*	488	*20·5*	1 893	*79·5*	3 329	1·8
1968	2 750	*100·0*	478	*17·4*	2 272	*82·6*	3 631	1·8
Airways corporations								
1965	129	*100·0*	49	*38·0*	80	*62·0*	220	2·8
1968	126	*100·0*	47	*37·3*	79	*62·7*	593	7·5
Transport corporations								
1965	234	*100·0*	76	*32·5*	158	*67·5*	301	1·9
1968	285	*100·0*	64	*22·5*	221	*77·5*	483	2·2
Electricity Council and boards								
1965	843	*100·0*	31	*3·7*	812	*96·3*	532	0·7
1968	971	*100·0*	93	*9·6*	878	*90·4*	705	0·8
Gas Council and boards								
1965	287	*100·0*	10	*3·5*	277	*96·5*	337	1·2
1968	363	*100·0*	62	*17·1*	301	*82·9*	489	1·6
General Post Office								
1965	546	*100·0*	296	*54·2*	250	*45·8*	1 521	6·1
1968	535	*100·0*	155	*29·0*	380	*71·0*	865	2·3
National Coal Board								
1965	261	*100·0*	25	*9·6*	236	*90·4*	360	1·5
1968	327	*100·0*	30	*9·2*	297	*90·8*	352	1·2
Broadcasting								
1965	81	*100·0*	1	*1·2*	80	*98·8*	58	0·7
1968	143	*100·0*	27	*18·9*	116	*81·1*	144	1·2

NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY

Relationship between the number of technicians and the number of persons holding degree or equivalent quelifications in engineering, technology and science: in functions other than research and development

Table S27

	QSEs						Total technicians (Number)	Number of technicians per QSE (excluding those employed as technicians)
	Total		Employed as technicians		Excluding those employed as technicians			
	Number	*Per cent*	Number	*Per cent*	Number	*Per cent*		
ALL NATIONALIZED INDUSTRIES AND PUBLIC CORPORATIONS IN SURVEY								
1965	16 799	*100·0*	1 989	*11·8*	14 810	*88·2*	69 167	4·7
1968	19 635	*100·0*	5 797	*29·5*	13 838	*70·5*	80 192	5·8
Airways corporations								
1965	179	*100·0*	108	*60·3*	71	*39·7*	1 327	18·7
1968	434	*100·0*	175	*40·3*	259	*59·7*	2 891	11·2
Transport corporations								
1965	1 787	*100·0*	706	*39·5*	1 081	*60·5*	10 214	9·4
1968	1 806	*100·0*	667	*36·9*	1 139	*63·1*	12 888	11·3
Electricity Council and boards								
1965	8 216	*100·0*	67	*0·8*	8 149	*99·2*	18 774	2·1
1968	10 600	*100·0*	3 574	*33·7*	7 026	*66·3*	17 239	2·5
Gas Council and boards								
1965	2 212	*100·0*	464	*21·0*	1 748	*79·0*	6 146	3·5
1968	2 507	*100·0*	437	*17·4*	2 070	*82·6*	9 275	4·5
General Post Office								
1965	885	*100·0*	521	*58·9*	364	*41·1*	25 871	71·1
1968	928	*100·0*	705	*76·0*	223	*24·0*	30 737	137·8
National Coal Board								
1965	2 797	*100·0*	118	*4·2*	2 679	*95·8*	5 315	2·0
1968	2 732	*100·0*	168	*6·1*	2 564	*93·9*	5 372	2·1
Broadcasting								
1965	723	*100·0*	5	*0·7*	718	*99·3*	3 510	4·9
1968	628	*100·0*	71	*11·3*	557	*88·7*	1 790	3·2

19 Questionnaire and definitions

19.1 The detail of the questionnaire used in the 1968 survey is shown overleaf.

19.2 It will be observed that the questionnaire is divided into two parts. Table A seeks information on: *Persons holding qualifications in engineering, technology and science* (*QSEs*), while Table B asks about the employment of: Persons *working as technicians or other technical supporting staff*. It is recognized that some persons included in Table A (QSEs) will also appear in line 21 of Table B.

Definition of QSEs. Part A

19.3 The definitions on page 1 of the notes gave a full list of the qualifications which persons must hold to be included in this table. Subsequently the Institute of Fuel and the Society of Dyers and Colourists were added to List (C) in Part A. The members of these institutes are included in all tables in Parts Two and Three.

Definition of technicians and technical supporting staff. Part B

19.4 A full description of the range of jobs held by technicians and other technical supporting staff is given on page 120 of the notes to the questionnaire.

THIS FORM SHOULD BE COMPLETED AND RETURNED BY 29th FEBRUARY, 1968

To MINISTRY OF LABOUR,
STATISTICS BRANCH C2 (H),
ORPHANAGE ROAD,
WATFORD, Herts.
(Tel. Watford 28500 Extn. 163 or 164)

SURVEY OF

ENGINEERING, TECHNOLOGICAL AND SCIENTIFIC MANPOWER

A. PERSONS HOLDING QUALIFICATIONS IN ENGINEERING, TECHNOLOGY OR SCIENCE

B. PERSONS WORKING AS TECHNICIANS OR OTHER TECHNICAL SUPPORTING STAFF

To:

FOR OFFICIAL USE
M.L.H. No.
Industry Group
Size Group

1. Please state the total number of persons employed on 13th January 1968 AT THE ESTABLISHMENT TO WHICH THIS FORM IS ADDRESSED. This figure should be the same as the "Total numbers employed" on any "L" return which you submit to the Ministry of Labour during January 1968. (see note below)

2. Does the establishment belong to a company which is a member of a group of companies? (i.e. Does it belong either to a subsidiary company or to one having subsidiaries as defined in the Companies Act?) Please enter "YES" or "NO".

If the answer to Question 2 is "YES" please give, in the space below the full name of the parent company of the group. Give the name of your company if it is the parent company.

3 Does your company or group own a separate research establishment employing personnel not included in this return? Please enter "YES" or "NO".

If the answer to Question 3 is "YES" please give, in the space below, the name and address of the research establishment.

4. Are any persons holding qualifications in engineering, technology or science (see enclosed Definitions 1 and 2) employed AT THE ESTABLISHMENT TO WHICH THIS FORM IS ADDRESSED? Please enter "YES" or "NO".

If the answer to Question 4 is "YES" please complete Table A overleaf.

5. Are any persons working as technicians or other technical supporting staff (see Definition 7) employed AT THE ESTABLISHMENT TO WHICH THIS FORM IS ADDRESSED? Please enter "YES" or "NO".

If the answer to Question 5 is "YES" please complete Table B overleaf.

Note: An "Establishment" is normally the whole of the premises, factory or shop at a particular address.

An "L" return is the monthly return, rendered by employers, showing the numbers of employees on the payroll.

PART A. PERSONS HOLDING QUALIFICATIONS IN ENGINEERING, TECHNOLOGY OR SCIENCE

NOTES ON TABLE A

A.1 This table should include all persons who hold the qualifications specified in Definitions 1 and 2 irrespective of the type of work on which they are engaged.

A.2 Full time directors, partners and working proprietors should be recorded in the line applicable to the first qualification obtained within Definition 1 and also, in total, in the box at the foot of Col. 5.

A.3 Persons with more than one qualification, in engineering, technology or science should be recorded in the line applicable to the first qualification obtained within Definition 1.

A.4 Persons with a general degree in science, or a degree which covers more than one branch of science, should be recorded in line 7.

A.5 Persons with a general degree in engineering, or a degree which covers more than one branch of engineering should be recorded in line 15.

A.6 Entries in Column 6 should exclude both replacements for posts which will become vacant after 1st January 1968 and new posts to be created after that date. (See also Definition 5).

TABLE A

PERSONS HOLDING QUALIFICATIONS IN ENGINEERING, TECHNOLOGY OR SCIENCE

employed at the establishment to which this return is addressed

Line No.	Subject of degree, diploma or other qualification (*See Notes A.1-A.5 above and Definitions 1 and 2*)	NUMBERS IN EMPLOYMENT Mainly engaged in the following activities at 1st January 1968			VACANCIES	FORECAST	Line No.
		Research and development (*see Definition 3*)	All other work (*see Definition 4*)	Total of Cols. 3 and 4	The number of vacancies at 1st January 1968 (*See note A.6 above*)	The number of persons you aim to have in your employment at 1st January 1971 (*See Definition 6*)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Agriculture						1
2	Biology						2
3	Chemistry						3
4	Geology						4
5	Mathematics						5
6	Physics						6
7	Combined sciences, general science and other sciences						7
8	Chemical engineering						8
9	Civil and structural engineering						9
10	Electrical engineering						10
11	Mechanical engineering						11
12	Metallurgy						12
13	Mining engineering						13
14	Production engineering						14
15	Combined engineering and other engineering						15
16	Materials technologies						16
17	Process technologies						17
18	Product technologies						18
19	Total 1 to 18						19
20	The percentage in line 19, (cols. (3)-(5)), engaged on defence contract work (direct, indirect, or by sub-contract)	%	%	%	not applicable		20

Total number of full time directors, partners, working proprietors included in Col. 5.

PART B. PERSONS WORKING AS TECHNICIANS OR OTHER TECHNICAL SUPPORTING STAFF

NOTES ON TABLE B

B.1 This table should include all persons working as technicians or other technical supporting staff irrespective of the qualifications held.

B.2 The range of jobs which may be held by technicians or other technical supporting staff is described in Definitions 7 and 8.

B.3 Some technicians or other technical supporting staff may have one of the qualifications listed in Definitions 1 and 2, and will therefore have been included opposite the appropriate branch of engineering etc. in Table A. Such persons should also be included in line 21 of Table B.

B.4 Columns 6 and 7 should be completed in respect of line 27 only.

B.5 The entry in the total line of column 6 should exclude both replacements for posts which will become vacant after 1st January 1968 and new posts to be created after that date. (See also Definition 9).

TABLE B

PERSONS WORKING AS TECHNICIANS OR OTHER TECHNICAL SUPPORTING STAFF

employed at the establishment to which this return is addressed

Line No. (1)	(2)	NUMBERS IN EMPLOYMENT Mainly engaged in the following activities at 1st January 1968 — Research and development (*see Definition* 3) (3)	All other work (*see Definition* 4) (4)	Total of Cols. 3 and 4 (5)	VACANCIES The number of vacancies at 1st January 1968 (*See note B.5 above*) (6)	FORECAST The number of persons you aim to have in your employment at 1st January 1971 (*See Definition* 10) (7)	Line No. (8)
21	Technicians who hold a degree or other qualification within *Definitions* 1 *and* 2 *(see also note B.3 above)*				not applicable (see note B4)		21
22	Technicians without qualifications specified by line 21 above but who hold a Higher National Diploma or Certificate						22
23	Technicians without qualifications specified by Lines 21 or 22 above, but who hold a full Technological Certificate or a Technician's Certificate of the City and Guilds Institute						23
24	Technicians without qualifications specified by lines 21 to 23 above but who hold an Ordinary National Diploma or Certificate						24
25	Technicians without qualifications specified by lines 21 to 24 above but who hold any other appropriate qualifications beyond 'O' level (see overleaf)						25
26	All technicians or other technical supporting staff not included in lines 21 to 25 above						26
27	Total 21 to 26						27

Signature of Employer or Manager..... Date.....

Person to whom enquiries about this return should be addressed (if other than above)

Name .....

Tel. No. .....

Line 25

If it is possible to specify the most common qualification (or qualifications) held by persons recorded against line 25 of Table B, please do so below:—

Title of qualification and awarding body	Number of persons

M773075 184603 6/67 26M J.B.Ltd. 6601 F (626)

DEFINITIONS

PART A: PERSONS HOLDING QUALIFICATIONS IN ENGINEERING, TECHNOLOGY OR SCIENCE

1. Qualifications (see 2 below for subjects)

(a) University degree
Degree of Council for National Academic Awards
Diploma in Technology (awarded by the National Council for Technological Awards)

(b) Associateship of the following educational institutions:-

	Abbreviations (if any)
Camborne School of Mines	A.C.S.M. or Dip. C.S.M.
City and Guilds of London Institute	A.C.G.I.
Cranfield College of Aeronautics	Dip. of-
Heriot-Watt College	A.H. -W.C.
Manchester College of Science and Technology	A.M.C.S.T.
Robert Gordon's Technical College, Aberdeen	
Royal College of Science (London)	A.R.C.S.
Royal College of Science (Ireland)	
Royal College of Science and Technology, Glasgow	A.R.T.C.
Royal School of Mines	A.R.S.M.

(c) Graduate or Corporate membership of the following:-

Line No.	
11	Royal Aeronautical Society
2	Institute of Biology
8	Institution of Chemical Engineers
3	Royal Institute of Chemistry
9	Institution of Civil Engineers
10	Institution of Electrical Engineers
10	Institution of Electronic and Radio Engineers
8	Institution of Gas Engineers
11	Institute of Marine Enginers
11	Institution of Mechanical Engineers
12	Institution of Metallurgists
13	Institution of Mining Engineers
13	Institution of Mining and Metallurgy
9	Institution of Municipal Engineers
11	Royal Institution of Naval Architects
6	Institute of Physics and the Physical Society
16	Plastics Institute
14	Institution of Production Engineers
16	Institution of the Rubber Industry
9	Institution of Structural Engineers
16	Textile Institute

2. List of subjects in which qualifications may be held

(see also alphabetical index on page 6)

Line 1, *Agriculture:-*

Agricultural economics	Agronomics	Horticulture
Agricultural science	Dairying/dairy science	Poultry science
Agriculture	Forestry	Veterinary science

Line 2, Biology:–

Agricultural biology	Biology	Microbiology
Agricultural botany	Biophysics	Mycology
Agricultural microbiology	Botany	Parasitology
Agricultural zoology	Ecology	Pathology
Anatomy	Embryology	Physiology
Animal physiology	Entomology	Soil science
Applied biology	Genetics	Virology
Bacteriology	Human biology	Zoology

Line 3, Chemistry:–

Agricultural biochemistry	Chemistry	Organic chemistry
Agricultural chemistry	Colour chemistry	Physical chemistry
Analytical chemistry	Crystallography	Physiological chemistry
Applied biochemistry	Industrial chemistry	Polymer chemistry
Applied chemistry	Inorganic chemistry	Technical chemistry
Biochemistry	Leather chemistry	Textile chemistry
Biological chemistry	Medical biochemistry	

Line 4, Geology:–

Geology	Mineralogy	Petrology
Geomorphology	Minerals science	Stratigraphy
Geophysics	Paleontology	

Line 5, Mathematics:–

Applied mathematics	Industrial mathematics	Numerical analysis
Computer science	Mathematical statistics	Pure mathematics
Computer technology	Mathematics	Technological mathematics

Line 6, Physics:–

Acoustics	Astro-physics	Mathematical physics
Applied physics	Chemical physics	Nuclear physics
Astronomy	Electronic physics	Physics

Line 7, Combined science:–

Applied science	General science	Natural science
Cybernetics	Mathematics/Physics	Oceanography
Ergonomics	Meteorology	

Line 8, Chemical engineering:–

Chemical engineering	Combustion engineering	Gas engineering
Chemical technology	Fuel engineering	Petroleum and oil engineering

Line 9, Civil and structural engineering:–

Civil engineering	Sanitary engineering	Water engineering
Highway and traffic engineering	Structural engineering	Water supply and purification
Municipal engineering		

Line 10, Electrical engineering:–

Applied electronics	Electronic engineering	Radio engineering
Automatic control	Electronics	Systems engineering
Control engineering	Power generation	Telecommunications
Electrical engineering		

Line 11, Mechanical engineering:–

Aerodynamics	Astronautics	Mechanical science
Aeronautics	Automobile engineering	Metrology
Aeronautical engineering	Dynamics	Naval architecture
Agricultural engineering	Marine engineering	Refrigerating engineering
Applied dynamics	Mechanical engineering	Thermodynamics
Astrodynamics		

Line 12, *Metallurgy*:–		
Metallurgical engineering	Metal technology	Physical metallurgy
Metallurgy		
Line 13, *Mining engineering*:–		
Metalliferous mining	Mining engineering	Mining geology
Minerals engineering		
Line 14, *Production engineering*:–		
Industrial engineering	Production engineering	Production technology
Line 15, *Combined and other engineering*:–		
Applied physical sciences	Engineering sciences	Nuclear technology
Biological engineering	Nuclear engineering	
Line 16, *Materials technologies*:–		
Ceramics technology	Materials technology	Polymer technology
Fuel science	Minerals technology	Rubber technology
Fuel technology	Paint technology	Textile technology
Glass technology	Paper science	Timber technology
Leather technology/manufacture	Petroleum and oil technology	Welding technology
Materials science	Plastics technology	
Line 17, *Process technologies*:–		
Brewing	Food science	Malting and brewing
Building science	Food technology	Printing
Building technology	Foundry technology	
Line 18, *Product technologies*:–		
Clothing and footwear	Machine tool technology	Semiconductor technology
Instrument technology		

3. Research and development

Persons directing or engaged on the following kinds of work should be included under research and development.

(a) Basic research: work undertaken for the advancement of knowledge.
(b) Applied research: research undertaken with either a general or a particular application in view.
(c) Development: including the construction of pilot plant or prototypes and work done under development contracts with Government departments, the Atomic Energy Authority and similar public bodies.

Exclude:– Routine testing and quality control, market research.

4. All other work

Persons engaged on work other than "Research and Development" should be included in column 4. This column covers those engaged in manufacture, production, maintenance, installation, design, management, sales, etc.

5. Vacancies

A vacancy is defined as a post which you are actively seeking to fill by the recruitment of a person holding a qualification in engineering, technology or science. To be included, such posts must be unfilled at 1st January 1968, i.e. include in "vacancies" any post for which a person has been recruited but has not yet taken up employment in your firm.

Vacancies at 1st January 1968 will not include replacements for posts which become vacant after 1st January 1968 or newly created posts which will become effective after that date.

6. Forecast

It is appreciated that it is sometimes difficult to forecast exact requirements three years ahead, and that plans may need to be adjusted within that time to meet changing economic conditions.

In column 7 please state your estimate of the total number you expect to be employing in 3 years' time, at 1st January 1971, assuming that the required persons are available. For example, if you now have 10 qualified staff and aim to recruit an additional 5 by 1st January 1971, the figure to be entered in column 7 will be 15. Please assume that you will have no vacancies at that date, i.e. that you will have filled your present vacancies and also any other vacancies which may have arisen between 1st January 1968 and 1st January 1971.

It is often possible that a post may be filled by a person holding a qualification in one of several possible subjects, e.g. physics or electrical engineering or combined engineering. In such cases when completing Columns 6 and 7 please record against the first preferred subject.

PART B: PERSONS WORKING AS TECHNICIANS OR OTHER TECHNICAL SUPPORTING STAFF

7. Description

Technicians and other technical supporting staff occupy positions between that of the qualified engineer, technologist or scientist on the one hand and the skilled foreman, craftsman or operative on the other. In most cases they are in jobs in research, development, design, production, operation or maintenanec in which they are either subject to the direction of an engineer, technologist or scientist or are engaged primarily in the application of proven techniques. Within these prescribed limits, their education end accumulated specialised skills enable them to exercise technical judgment. By this is meant an understanding, by reference to general principles, of the reasons for and the purposes of their work and an ability to select the appropriate established techniques and skills to carry it out.

In some industries and in research, wide agreement has been reeched on the role of a technician. In some industries, as for example construction, many technical supporting staff work without direct supervision from professional staff but should nevertheless be included in this survey. In a number of industries, certain supervisory, office, and sales jobs are also technical in their character, i.e. involve the exercise of technical judgment.

It has been found that most difficulty occurs in defining technicians or other technical supporting staff where supervisory or testing duties are carried out. Jobs of the foreman or junior manager type should therefore be included only if the holder is also required to exercise the kind of independent technical judgment referred to above. Testing should be excluded, unless it is more than routine and calls for the exercise of this judgment.

In identifying technicians and other technical supporting staff it is essential to consider the job being done rather than the qualifications held. Many technicians and technical supporting staff will possess qualifications such as the Higher or Ordinary National Diploma or Certificate, or the City and Guilds Institute technicians' awards and similar nationally recognised awards. Some may possess a degree in engineering, technology or science. Others may not possess any formal qualification.

Persons working as technicians or other technical supporting staff while still under training should be included in this survey.

Supporting staff auxiliary to the medical or dental professions (e.g. nursing, dental mechanics, etc.) should be excluded.

8. Range of jobs held by technicians or other technical supporting staff

Technicians and other technical supporting staff are normally found among workers in the following fields:–

(a) The detailed design and development, or the manufacture, erection or commissioning of equipment and structures; drawing, estimating, inspecting and testing equipment; use of measuring instruments; operating, maintaining and repairing machinery, plant and services and locating defects therein; process control; activities connected with research and development, testing of materials and components; technical advice to customers; servicing equipment; data processing; work study.

(b) Assisting qualified scientists in such activities as physical measurements; collection and evaluation of experimental observations; the devising and setting up of experimental apparatus; the preparation of chemicals or biological cultures or similar preparations in other fields; photographic work; the taking and testing of product samples; chemical analysis, etc.

Examples of job titles common to more than one industry:–

Junior computer programmer and systems analyst
Design assistant
Draughtsman
Experimental officer
Laboratory technician
Operational research assistant
Photographic assistant
Plant maintenance technician, installer
Plant and site supervisor
Production planner
Safety officer
Scientific assistant
Service engineer/technician
Technical author/writer
Technical assistant in research laboratory
Technical sales and contracts staff
Tester, calibrator, inspector, analyser
Work study technician
Estimator
Surveyor

Examples of job titles within particular industries:–

Aircraft
Junior stressman
Flight trials technician

Chemical
Process foreman
Glass blower

Construction
Building technician
Civil engineering technician
Contracts manager
Buyer
Site manager
Quantity surveyor

Cotton spinning and weaving
Automatic loom overlooker
Carding or spinning overlooker
Fabrics designer

Engineering
Electrical/electronics technician
Electrician
Prototype wireman

Furniture and timber
Prototype maker of furniture
Pole fabricator (laminated masts)
Infestation controller

Food processing
Domestic science worker
Food process technician
Skilled experimental chef
Quality inspector

Iron and steel
Control systems technician
Engineering workshop technician
Instrument technician
Metallurgical technician
Fuel engineering technician
Chemical technician

Motor manufacture
Supplier liaison engineer
Junior chassis design engineer
Supervisor, clay modelling
Supervisor, packing

Wool, jute and flax
Woollen combing engineer
Weaving overlooker
Worsted carding engineer
Combing overlooker
Worsted spinning overlooker
Woollen spinner

NOTE: There are obviously many more job titles describing the roles of technicians and other technical supporting staff than are given above. The above lists are merely illustrative of the wide range of jobs, and *must not* be taken as being exhaustive.

9. Vacancies (technicians)

A vacancy is defined as a post for a technican as defined in 7 and 8 above. To be included, such posts must be unfilled at 1st January 1968, i.e. include in "vacancies" any post for which a person has been recruited but has not yet taken up employment in your firm.

Vacancies at 1st January 1968 will not include replacements for posts which become vacant after 1st January 1968 or newly created posts which will become effective after that date.

10. Forecast (technicians)

It is appreciated that it is sometimes difficult to forecast exact requirements three years ahead, and that plans may need to be adjusted within that time to meet changing economic conditions.

In the total line (line 27) of column 7 please state your estimate of the total number you expect to be employing in 3 years' time, at 1st January 1971, assuming that the required persons are available. For example, if you now have 10 persons working in posts which come within Table B (Definition 7 and 8 above) and aim to recruit an additional 5 by 1st January 1971, the figure to be entered in column 7 will be 15. Please assume that you will have no vacancies at that date, i.e. that you will have filled your present vacancies and also any other vacancies which may have arisen between 1st January 1968 and 1st January 1971.

ALPHABETICAL INDEX OF SUBJECTS

Appendix

20 Data from the Censuses of Population

20.1 A question on the qualifications held by all persons in the household was included, for the first time in the census questionnaire, in a ten per cent sample of households in 1961.

20.2 The actual terms of the question on the schedule, which were agreed with the Statistics Committee of the Advisory Council on Scientific Policy, were as follows:

For Persons Aged 15 And Over
Persons with qualifications in science and technology.
State at (i) the academic and/or professional qualifications held.
State at (ii) the main branch of science or technology in which science or technology in which the qualifications are held.
Q
(i).....
(ii).....

The answers were coded to definitions consistent with those used in the manpower surveys addressed to employers. In 1966 the question was extended to cover all qualifications obtained beyond the age of 18.

20.3 Comparisons can now be made on a firmer basis than at previous times by using the two census benchmarks (for 1961 and 1966) and data from the manpower surveys 1959 and 1962, 1965 and 1968 occurring respectively either side of the census points. The situation was very different at the time when only one benchmark 1961 and two manpower surveys 1956 and 1959 were available—both occurring before the census.

20.4 Thus the view derived in the General Register Office report quoted below is now superseded by the availability of new data from both sources. The notes are however quoted for reference since the distinctive features of the data from the two sources have remained substantially the same throughout the series.

20.5 The General Register Office report, *'Census 1961, Great Britain, Scientific and Technological Qualifications'*,[1] (London HMSO 1962), pages xiii and iv, outlined some of the difficulties of comparing these data with data given by the 1956 and 1959 surveys of engineering and scientific manpower and, at the time of writing, concluded that direct comparison between the census data and the results of these surveys was not possible. The six points raised, which may be usefully recalled at this stage of the discussions were:

'(1) The census data derive from a compulsory and comprehensive enquiry directed to all persons in a representative one-tenth of private households (and of persons in institutions and hotels); the Ministry of Labour survey was a voluntary enquiry directed to employers in a limited range of industrial activity. In the 1959 survey a response of about 80 per cent was obtained, and, in allowing for this, it was assumed that the proportion of qualified persons in each industry was the same in both non-responding and responding establishments.

(2) The Ministry of Labour inquiry separated several nationalized industrial units and public corporations which were not so separately identified in the 1961 Census (which dealt with persons not establishments). Such nationalized units do not fit precisely into the rubrics of the Standard Industrial Classification, e.g. while the BOAC and BEA form the bulk of MLH 706, the BBC is only a minor part of MLH 881.

(3) A number of groups covered by the Census were excluded from the 1959 survey.

(4) The fact that the approach by the Ministry of Labour was to the employer rather than to the qualified person himself may have had some effect on the allocation to the subject in which persons were returned as qualified. In the survey, each person (other than those holding BSc (Tech) or DipTech only) had to be allocated to a specific branch of science, engineering or technology. Where a person held a degree in science or engineering which was not one of the specified branches (e.g. a general or ordinary degree in science) or had a qualification in more than one branch, the employer was asked to record the person in the branch most appropriate to the work in which he was engaged.

(6) In the survey, employers would include only persons with qualifications known to them and might not include qualified persons employed in occupations with no clear direct relation to scientific and technological qualifications.

(6) There wes en interval of over two years betwaen the 1959 survey and the Census.'

20.6 The Censuses of Population 1961 and 1966 give the two benchmarks in the historicel series. In the second ten per cent sample Census of Population for April 1966, the data collected include all qualifications gained after the age of 18. The tabulations used in the studies described in this report related to the first stated degree or equivalent qualification within the subject fields engineering, technology and science and are thus directly comparable with the tabulations from the 1961 Census of Population.

20.7 Between the Censuses of 1961 and 1966 there were two manpower surveys, in 1962 and 1965. These surveys covered nearly 80 per cent of the totel OSEs in employment in Great Britain, the main exceptions being egriculture, distribution, banking, insurance end medicel services. Thus with the 1968 survey there ere (for the sectors covered) the two census benchmarks and four other data points covering the period 1959 to 1968.

20.8 The distinctive features of the data from the two sources, outlined in pere above have remained substantially the same throughout the series. There were minor developments in coverage between 1959 end 1962. Persons holding a qualification in the subjects, egriculture, rubbar, plastics and textile technology were first included in the survey in 1962, but these changes, of course, affact only a few industries.

Adjustment of ceneus date

The ten per cent sample census—1961

20.9 The Ganeral Register Office carried out e study of the census mathod by which the 'ten per cent aample' within the 1961 census waa selected. Certain items common to the full census and the ten per cent sample were compared. The findings on bies were reported in the sample census volumes e.g. *Industry Tables Part I*[2] (pagas xviii and following) in the following terms:

'After the 1961 Census, the 10 per cent sample was checked for bias by compering certain items of informetion common to the full census and the sample census. One such comperison showed clearly that the sample of households wes biased. Although the total number of households in the sample is elmost exactly one-tenth of the total in the whole country, the distribution of households by number of persons end number of rooms occupied is distorted. The emount of bias is shown in the table below.

Percentage excess in 10 per cent sample when compared with one-tenth of the full count figures.

	All house-holds	Number of room occupied						
		1	2	3-4	5	6	7-8	9 and over
All households	+0	—10	—6	—1	+0	+3	+8	+17
1 person	—8	—11	—11	—8	—7	—4	—2	+10
2-6 persons	+2	—7	—3	+0	+1	+6	+8	+20
7 persons and over	—10	—22	—28	—14	—10	—9	—7	—1

There is considereble under-representation of one-person households end of large households. For eny stated size of household there is e clear gradient from too few households occupying few rooms towerds too many households with large numbers of rooms.

To ellow for this bias, correcting factors have been calculated which users can apply to the 10 per cent census date. It was not e practicel proposition to calculate such factors for every entry in the tables. Instead they have been obtained for certain of the more important marginal totals.'

20.10 One further paragraph should also be noted:

'It is important thet these bies factors be correctly interpreted. They ere only intended to remove thet element of bias associated with the classification of households by numbers of persons/by number of rooms/by sharing stetus/by erea. They do not remove other elements of bies which mey exist end may be fundamentally associated with some other chereeteristic such as occupation.'

20.11 Factors specific to aix groups of subject were, however, calculated in Merch 1965, and these ere considered to be the most suitable for application to deta for QSEs. These are given in Teble 53. It will be noted that they are ell slightly lower than the factors for Occupational Order XXV, leading to a larger downwerd edjustment of date for QSEs. Bies correction factors for QSEs ware calculated for the totals only within 'Menufacturing' for each subject group. In the abaence of evidence to the contrary, it is assumed thet the source of bias hes no differential influence on number of QSEs who ere economically active.

The sample census data—1966

20.12 The sample census in 1966, by its nature, could not be checked for bias in the manner described by GRO for the 1961 ten per cent semple. There is no evidenca either way about bias arising from the census method. Howevar a comparison of the census enumeration and the 'best estimate' of home population calculated from 1961 census data, plus consideration of flows and data from the 1966 sample census itself, has led the GRO to the conclusion that the 1966 sample census data are deficient by 1.5 per cent overall for Great Britain.

20.13 The 'deficiencies' have been calculeted by GRO eeparately for each age-group end for males and females separately. The GRO have etressed that there is no other evidence of bias in other deta from the sample censue and they are unable to say how the sources of bias may have affected data on specific cheracteristics such as QSEs. The best that can be done for OSEs is to apply theee age-sex correction factors in the most sensitive way posaible with the data available.

20.14 Aa an indication of the effect of these correction factors on numbers of qualified manpower the overall factors are calculated. These are:

Overall bias correction factors—1966

All QSEs	1·0256
Males	1·0256
Females	1·0196

i.e. to derive best estimate for Census 1966, multiply data for QSE males by 1.0266.

20.15 The factors calculated by the GRO differ widely between age groups with a sharp drop after 30-34 for males and 25-29 for females consistent with the observation that some, at least, of the under-enumeration is caused by deficiencies in the sampling frame arising from delayed recording of new hereditaments (see Table 55). As a result, the application of these factors to particular sectors, between which age and sex distributions have considerable variation, produces significantly different sector bias correction factors.

20.16 Age distributions for QSEs have been tabulated by the Office of Population Censuses and Surveys, by economic status, sex and subject of qualification. These data have been used to derive age-weighted, sex-subject-specific bias correction factors for QSEs. The results are shown in Table 55.

20.17 These factors were applied seperately to all 40 sectors to derive a first approximation to bias-adjusted data for 1966. An illustration of the result of applying these QSE factors to data for all manufacturing is given in Tables 54.

QSEs employed in manufacturing—1966 Census

Adjustment for age-sex specific bias

Table 54	Number employed	Bias correction factors	Adjusted data
All subjects	**109 740**		**112 737**
Engineering	64 690	1·0254	66 603
Technology	6 600	1·0266	6 648
Science:	36 260		37 265
Males	34 460	1·0290	35 469
Females	1 790	1·0205	1 627

20.18 It will be noted that, in the absence of an analysis by subject by sex for engineering and technology within each manufacturing industry, the sex-weighted factors have been used for these subjects. The loss of precision is negligible, due to the relatively small numbers of female QSEs in manufacturing.

21 Migration

21.1 The sources and methods used in making the original estimates are described in pages 76 to 76 of the *Report of the Working Group on Migration.* (6) These pages are reproduced on pages 129 to 130. This section gives further details of sources and methods used in making the current estimates (see also Part Two, Section 3).

21.2 Following the publication of the Report in August 1967, additional data became available from the 1966 census. The estimates are revised so as to include certain groups of migrants not previously

QSEs employed in manufacturing—1961 Census

Adjustment for subject-specific bias compared with adjustment for occupation-specific bias

Table 53	Number employed 1961	Subject-specific bias correction factors	Adjusted data	
			Using subject-specific factors	Using constant factor 0·9776* (Occ. Grp. XXV)
ALL SUBJECTS	97 140		94 162	94 972
Total engineering	**59 990**		**56 217**	**58 648**
Chemical	2 660	0·9691	2 676	2 603
Civil and structural	2 760	0·9699	2 666	2 720
Electrical	16 350	0·9699	15 666	16 691
Mechanical	32 930	0·9711	31 976	32 191
Mining	390	0·9691	376	383
Other engineering	4 670	0·6661	4 719	4 760
Total technology	**6 100**		**5 912**	**5 966**
Metallurgy	3 630	0·9691	3 609	3 645
Other technology	2 170	0·9691	2 103	2 121
Total science	**31 050**		**30 033**	**30 369**
Agriculture	1 220	0·6649	1 177	1 166
Biology	640	0·9649	611	622
Chemistry	16 690	0·9649	16 267	16 509
Geology	210	0·6649	203	206
Mathematics	2 070	0·9726	2 013	2 026
Physics	6 670	0·9726	6 606	6 836
General and other	3 660	0·9677	3 726	3 765

* Summation of data calculated for 21 industry sectors.

Sources: Office of Population Censuses and Surveys
Ministry of Technology

identified. These are:

(a) QSEs who are not in gainful employment;

(b) Teachers, managers, medical workers;

(c) Migrants who are Irish or foreign born.

Foreign born QSEs

21.3 The immigration of the foreign born QSEs is estimated from:

(a) the base year 1965 and,

(b) estimates for the earlier years are obtained by taking the base year as 100 and working back using the main series (integrating sea manifest, IPS and professional institution data) as an index of change. This gives total immigration for the five years 1961 to 1965.

The emigration of the foreign born QSEs is estimated by:

(c) taking the difference between the net increase in numbers in the country (Table 56) and the estimate of total immigration obtained under (a) and (b);

(d) the approximate calendar year estimates for foreign born QSEs are derived from total emigration, pro-rating with the known sources of British and Commonwealth emigrants (Table 57).

21.4 It should be noted however, that some foreign born persons can take a first qualification in Great Britain and then take up employment. They will then appear in the 'net increase' without having featured in immigration. The number is probably small but, to the extent that it exists, will decrease the estimate of emigration.

21.5 This method can be illustrated by foreign born QSEs with science qualifications. Table 56 shows that the net increase between 1961 and 1966 was 2030. The census 1966 showed that 1965 immigration was of the order of 925. Obtaining an index from the sea manifests, an aggregate of 4230 is obtained from immigrants and 2200 for emigrants (Table 57). A complete set of figures for this stage of the estimation is shown in the table. The estimates for Northern Ireland and Eire are prepared in the same way.

Immigration in calendar year 1965

(Reference paragraph 3.7)

21.6 A special extraction was made from the sea manifest data in 1961 to ascertain the proportion of QSEs who entered or left Great Britain in the first 17 weeks. The results are shown in the table and indicate that the international flow of QSEs was concentrated in the latter half of the year. For engineering, less than a third moved in the first 17 weeks; for science it was less than a quarter.

Age-sex specific bias correction factors for the 1966 sample census applied to each subject group for all in employment

TABLE 55	Bias correction factor	All subjects		Engineering		Technology		Science	
		Census	Adjusted data	Census	Adjusted data	Census	Adjusted data	Census	Adjusted data
MALES AND FEMALES		303 740	311 565	150 570	154 554	13 520	13 909	135 550	143 422
Weighted correction factor			*1·0271*		*1·0264*		*1·0288*		*1·0277*
MALES									
All ages		262 250	269 063	150 330	154 304	13 450	13 838	118 510	121 551
Weighted correction factor			*1·0276*		*1·0264*		*1·0259*		*1·0290*
Less than 25	*1·0500*			6 590	10 070	560	903	10 600	11 130
25-29	*1·0436*			24 300	25 359	3 110	3 246	23 770	24 806
30-34	*1·0512*			21 750	22 864	2 100	2 206	19 740	20 751
35-39	*1·0215*			24 090	24 615	2 050	2 095	16 640	16 251
40-44	*1·0171*			24 100	24 512	1 550	1 577	12 200	12 406
45-49	*1·0307*			13 640	14 065	1 040	1 072	9 010	9 287
50-54	*0·9968*			12 420	12 380	1 020	1 017	6 240	6 219
55-59	*0·9993*			5 450	5 443	780	776	7 540	7 535
60-64	—			7 220	7 220	590	590	5 110	5 110
65-69	*1·0049*			2 210	2 221	160	161	1 320	1 326
70 and over	*0·9961*			1 360	1 355	70	70	1 140	1 136
FEMALES									
All ages		21 450	21 892	340	350	70	71	21 040	21 471
Weighted correction factor			*1·0206*		*1·0294*		*1·0143*		*1·0205*
Less than 25	*1·047*			120	126	10	10	3 860	4 062
25-29	*1·046*			60	63	30	31	3 620	3 767
30-34	*1·018*			50	51	10	10	2 400	2 443
35-39	*0·999*			40	40	10	10	2 490	2 486
40-44	*0·997*			20	20	—	—	1 630	1 625
45-49	*1·009*			20	20	10	10	1 700	1 715
50-54	*1·006*			20	20	—	—	1 950	1 962
55-59	*1·005*			10	10	—	—	1 620	1 629
60-64	*1·008*			—	—	—	—	860	866
65-69	*0·997*			—	—	—	—	230	229
70 and over	*1·022*			—	—	—	—	140	143

Sources: Office of Population Censuses and Surveys
Ministry of Technology

QSEs leaving or entering Great Britain between January 1 and census date 1961 as proportion of calender year total.

	Immigration	*Emigration*
Engineering	0·2941	0·2636
Science	0·2136	0·1893

Source: Board of Trade

21.7 Then assuming, in the absence of avidence to the contrary, that a similar pattarn of migration is prasent in more recent years, the 1965 census estimata can be adjusted to a calendar year basis. An iterative procass was used. Initially it was assumed that the census total of those reporting an eddrass outside Graat Britain one yeer prior to that on census night was aquivalent to the calendar yeer 1965. This estimata was used to produce an estimate of the immigration in the calender yaar 1966 using the IPS link. From this 1966 estimate, the proportion of QSEs arriving in the 17 weaks before the census data in April 1965, could be estimatad. This estimate was daductad from the recorded cansus immigration figure, giving an estimata for the calandar yaar 1965, less the first 17 weaks. Using the factors ebova it was than possibla to gross up the figure for tha past year to a full calendar yeer. In practice the adjustment is appropriate only to thet part of tha population not associated closely with the acadamic yaar. In other words it does not apply to teachers and studants who generally mova in July to September.

21.8 The actual diffarencas ere minimal and well within the sampling error but tha arithmatic has bean carried through the ramaining stages.

Comprehensive estimates

21.9 Tha method of making tha comprehensive estimates is described in Section 3. The estimates are shown in full in Tables 19 to 23.

QSEs who were born overseas

Growth in numbers in employment[1] 1961 to 1966

Table 58	1961	1966	Increase 1961 to 1966	
			Number	*Per cent*
ALL SUBJECTS				
Total	22 760	28 320	+5 540	*+24·3*
Foreign born	7 770	12 260	+4 490	*+57·9*
Commonwealth and Irish Republic	15 010	16 060	+1 060	+ 7·0
ENGINEERING AND TECHNOLOGY				
Total	11 410	14 090	+2 680	*+23·5*
Foreign born	4 340	6 800	+2 460	*+56·7*
Commonwealth and Irish Republic	7 070	7 290	+ 220	*+ 3·1*
SCIENCE				
Total	11 370	14 230	+2 860	*+25·2*
Foreign born	3 430	5 460	+2 030	*+58·2*
Commonwealth and Irish Republic	7 940	8 770	+ 830	*+10·5*

[1] No information are available from the 1961 census of the number of foreign born QSEs who ere economically inactive It hes to be assumed therefore, that the inflow and outflow of students and other inactive migrants is in balance.

Source: Office of Population Censuses and Surveys

QSEs who are foreign or Irish born

Figures from the census are printed in italics

Table 57	Engineering and technology			Science		
	Immigration	Emigration	Balance	Immigration	Emigration	Balance
FOREIGN BORN						
1961 to 1965	2 770	310	*+2460*	4 230	2 200	*+2030*
1961	650	45		800	375	
1962	610	55		880	375	
1963	445	50		825	435	
1964	460	70		800	490	
1965	*615*	80		*925*	525	
IRISH BORN[1]						
1961 to 1965	700	590	*+ 110*	805	390	*+ 415*
1961	165	85		150	70	
1962	155	100		165	65	
1963	110	115		165	75	
1964	115	140		160	85	
1965	*155*	150		*175*	95	

[1] Northern Ireland and the Irish Republic.

Sources: Office of Population Censuses and Surveys
Ministry of Technology

Extract
'The Brain Drain. Report of the Working Group on Migration'—pages 76 to 78:

Statistics

1. The purpose of this Appendix is to describe how the estimates of engineers, technologists and scientists leaving and entering the United Kingdom between 1961 and 1966 were compiled.

Definitions

2. For the purpose of this analysis, an emigrant was defined as a person who goes abroad intending to stay away for a year or more. Similarly an immigrant is one who comes to the country intending to stay for a year or more. This definition is used in international studies such as that now being undertaken by the OECD. It includes graduates going abroad for research or further study, graduates taking short-term posts or undertaking short-term contracts, visitors and travellers making extended visits abroad and finally, those who leave this country intending to make their home abroad. As the period with which we are concerned is more than a year, the movement abroad of any of these categories of emigrant means a loss, temporary or permanent, to the working population. Immigrants by the same definition will increase the working population.

Sources and methods

3. As explained in paragraph 23 of the report the data used for this study have not been obtained from a specially designed series of surveys; they have been collected from many sources with some differences of definition and coverage. As a result, data for different groups of migrants suffer from some lack of comparability. However, a point to remember in appraising statistics in this field is that migration is itself an imprecise concept. The only thing that distinguishes a long-term visitor from a 'migrant' is intention. Intentions can change over time, but the statistics cannot be retrospective. For instance, an engineer visiting relatives in Australia may be persuaded to stay, thus becoming an emigrant or, alternatively, an engineer going to Australia with the intention to stay permanently may in fact return to this country before the year is up. Similarly, a qualified man may go abroad on a short-term contract and later choose not to return.

4. Statistics were collected from the sources listed below:

(i) Annual returns made by the professional engineering and scientific institutions;

(ii) *First Employment of University Graduates*—1961-62 to 1965-66—University Grants Committee;

(iii) Movement of university teaching staff overseas—University Grants Committee;

(iv) Emigration from and immigration into the aviation and electronic industries—Ministry of Technology;

(v) *Emigration of Scientists from the United Kingdom*—Engineers and scientists with doctorates, leaving the universities 1952 to 1962—Council of the Royal Society;

(vi) Migration by the long sea routes to and from countries outside Europe, 1956 to 1963—Board of Trade and General Register Office*;

(vii) Nominal roll of assisted immigrants to Australia by sea and air—Commonwealth Relations Office;

(viii) *Immigration*—Department of Citizenship and Immigration of Canada;

(ix) Immigrants with professional occupations admitted to USA—United States Department of Justice†;

(x) Vouchers for Commonwealth immigrants—Ministry of Labour; and

(xi) Qualified engineers and scientists going to posts in developing countries for technical assistance—Department of Overseas Development.

Emigration

5. Statistics were collected by subject of qualification or, failing that, by scientific or engineering occupation and, for the purpose of the survey, the fourteen subject groupings distinguished in the 1961 Census of Scientific and Technological Qualifications were used. The fourteen separate annual estimates were finally aggregated to give a measure of the brain drain.

6. Despite the very substantial amount of information, some gaps remained. In particular, the estimates of the number of former immigrants from Commonwealth countries returning home were originally made from the information obtained from the sea manifests, which are no longer available; from 1964 onwards the number of returning residents has been kept at about the 1963 level. It is believed that up to 96 per cent of the movement of graduates in some subjects, e.g. physics or electrical engineering, has been directly assessed. For graduates in other subjects (e.g. agriculture) about whom there is less information, the overall figure in 1964, 1965 and 1966 must be more tentative. It needs to be stressed therefore that the *overall* statistics as used in the report convey orders of magnitude only rather than precise figures.

Immigration

7. There are no comparable figures of graduates or persons with equivalent qualifications who enter this country, whether they are UK citizens or graduates from the Commonwealth.

8. Data of immigration of qualified persons by the long sea routes were available up to 1963 but thereafter were discontinued. Up to then the problem was to estimate the number who entered the country by air. From the analysis of the estimates already made of graduate emigrants in each subject, it was possible to discover the *proportion* of the total number who went by sea and from this the *proportion* who went by air in each year. These proportions proved to be stable over the period 1958 to 1963; there was no perceptible trend in the figures for each destination, although, as might be expected with such imprecise data, there were slight fluctuations from year to year. To obtain an approximate estimate of total immigration it was assumed that the proportion of, say, chemists travelling by air *from* the United States was the same as the proportion travelling by air *to* the United States. Where this hypothesis could be checked it suggested that the additions for air immigration might be too low and that the estimates so obtained understated the total of immigration. More recent data from the professional institutions have also suggested that the earlier estimates were too low.

*The General Register Office also publish statistics on migration in the Registrar General's Quarterly Returns.

†Statistics for 1962-1964 have been published in *Surveys of Science Resources Series*, National Science Foundation—NSF 67—3.

9. From 1964 onwards, dete from the see manifests have been discontinued end estimetes cen no longer be mada by this method. Howaver, e number of tha professional scientific end engineering institutions have provided dete on the immigretion of their members, peralial to those which they heve provided for emigretion. These dete do not cover the whole field nor do thay cover non-members, but they heve enebled rough estimates to be mede of the overall level of the return flow. The Ministry of Lebour figures of vouchers issued to Commonweelth immigrents have elso been used in meking the estimates. Nevertheless, the figures from 1964 to 1966 must be considered orders of magnitude only end, for this reason, ere printed in italics.

22 Flow models

Date used in the flow models

22.1 The date used in the flow models ere described under the following heeds:

(a) numbers employed et 1961 end 1966 census;

(b) date of first employment of graduates provided by the university eppointments officers and published by the University Grants Committee;[12]

(c) deaths as described in Section 4;

(d) retirement essessed from ectuariel procedures using active/inactive retios from census;

(e) Migrents in eppropriete disciplines.

Purpose of the models

22.2 In the general essessment of the employment of QSEs, the flow models described here (the precursors of the complete modelling system by discipline) have three purposes:

(a) to produce ennuel estimetes of employment whera no other series of employment dete ere eveileble, e.g. distribution, finence, benking;

(b) to act as a check on grossing-up procedures where the mejor pert of the sector is covered by survey deta (es in e netionalized industry) but where it is known that the private sector, mey not necessarily be opereting in a eimilar menner. Order II Mining and quarrying, is an exemple of thia; the model ects ae a valueble eacond string in estimating for the privete sector;

(c) to examine why it is thet employment of QSEs in construction and consulting cen continue to grow despite heavy emigration from 1965 onwards;

(d) to examine what heppens within a growing eector, such as manufacturing, when it experiences e temporary receesion end crisis of liquidity.

22.3 The atudy and understending of flowe within the eystem is essential for two purposes:

(a) to extend the intercensel estimates to eerlier yeers end up to 1968;

(b) to make estimetes of QSE employment beyond 1968.

22.4 The inter-reletionship of the flows is of immense importence; they are known to differ merkedly for the science group and the engineering group of QSEs. In Orders XX end XXI, (Distributive trades end insurance, benking finence), for instance, e lerger proportion of the entry of science QSEs cen be shown to be greduates; in the engineering group on the other hend the entry consists largely of movement from other sectors of the economy. Such en obsevetion prompts the question—where ere these engineering QSEs coming from end why did they leave their previous employers? Ageln, it must be appreciated that 'graduete' members of profeseional institutions would be unlikely to enter a post in Orders XX or XXI unless such experience would entitle them to 'corporete' membership of their professionel institution. Such inbuilt fectors for professionel employment are of importance in interpreting model flows.

Working notes

22.6 This system of modelling recognizee two besic principlee:

(a) In a steady stete, there will be a normal circulation of QSEs betwaen employers seeking further experience. Between companiee thia mey rlee ae high es 6 per cent (es much as 10 per cent efter three yeers in the company), but, *between* eectors, obsevetion suggests that it mey be ebout 2 per cent.

(b) In addition to normal mobility, there will be en outward flow caused by special circumstances. These have included:

  (i) e long-term fall in QSE employment in an industry;

  (ii) speciel occurrencee, for example, the cancellation of Government eircreft contrects;

  (iii) general leck of growth in en induetry;

  (iv) long-term growth of e sector, accompanied by repid turnover of QSEs.

22.6 The evidence of thia special or 'excese' mobility la found in two weye:

(a) by finding that the estimete of amigration for any one year cennot be conteined within the estimate of 'normal mobility';

(b) by finding thet an intercensel fall in employment indicates en outward flow for the five yeers greeter then cen be accommodeted within the estimete of 'normal mobiiity';

(c) by finding that recruitment and immigration together are too large for the observed growth of the sector.

22.7 In April 1970, the Department of Employment and Productivity published, for the first time, 'Approximate estimates of the flow of employees between industries'.[9] For all male employees the figure given was 9.7 per cent outflow between industry (SIC) Orders or 5.2 per cent manufacturing to other industries. Experience suggests that the corresponding figures for QSEs are rather lower, possibly due to a relatively smaller proportion of short-term jobs. As a first approximation the models were worked on the assumption of 2 per cent 'normal circulation'; in practice this was found to be not inconsistent with other flows. The concept of excess mobility (see 22.6 above) allows for variation from industry to industry.

Outward flow

22.8 Unless (a), (b) and (c) of paragraph 22.6 are in evidence, the total outward flow is assumed to consist of:

(i) deaths;
(ii) retirements;
(iii) normal mobility.

Emigration must be treated as an indicative flow rather than as a dominant feature of the models. The level of emigration appears to be affected very little by the economic condition of the sector in which the QSE was previously employed. This is because emigration can be a response to three markedly different situations, a part of normal mobility, the search for alternative employment in a situation of uncertain prospects or political crisis (the 'push' factors); or the response to more attractive or well-paid employment overseas (the 'pull' factor). In practice these three situations interact, but the distinction is nevertheless of use in an analysis of a series of estimates.

Where emigration exceeds normal mobility

22.9 Analysis of estimates for earlier years will have shown the extent to which 'normal mobility' exceeds emigration. Even where emigration rises sharply, not all QSEs associated with 'normal mobility' will emigrate and a notional figure (say the mean difference shown in the series) must be maintained before estimating total outflow. In this situation, for the years in question, total outflow will consist of:

(a) death;
(b) retirement;
(c) normal mobility } emigration + minimum to
(d) excess mobility } other sectors.

The distribution of excess mobility over the five years is adjusted to fit in with the economic circumstances known to be reflected in emigration changes. This is considered to be the inverse of the cyclical changes in recruitment. For example, low recruitment to the manufacturing sector in 1963 is accompanied by high excess mobility.

Inward flow

22.10 The inward flow to each sector for the five-year period is assessed by adding the estimated outward flow to the net intercensal change.

22.11 Flows separately distinguished in the model are:

(a) new graduates (first or higher degrees);

(b) new members of professional institutions (free of duplication);

(c) graduates leaving educational establishments after having obtained; postgraduate diplomas or other non-degree qualifications;

(d) inflow from other sectors;

(e) inflow from abroad.

22.12 The number of graduates leaving universities or other education establishments with qualifications other than degrees is not reported by the appointments officers. For this purpose, this additional flow has to be included with 'inflow from other sectors'. In so far as non-degree courses in specialized subjects and post-experience training are usually associated with a particular sector, it is unlikely that the absence of information at this point will cause distortion in the overall pattern.

22.13 Unlike emigration, the inward flow from overseas posts (e) is very sensitive to the economic climate at home, particularly for QSEs with engineering qualifications. There is evidence that companies contemplating new installations or other extensions of their business tend to bring home their own employees from overseas subsidiaries or to recruit people who have had overseas experience with other companies.

Reconciliation of industry groupings for flow models

22.14 In their annual returns of 'first employment' the university appointments officers indicate the 'employment categories' in which the graduate takes his first post. It has been possible to allocate these broad groupings to MLH headings of the Standard Industrial Classification.[13] The detail of this reconciliation is shown overleaf:

Reconciliation of UGC and SIC industry groupings for flow models

	'Employment categories' as used by the University Grants Committee	Standard Industrial Classification (1958)	
Sectors not covered by the survey		Order	MLH
Agriculture	Agriculture, forestry, horticulture	I	
Medical services	Local government authorities and hospital services; the following subjects only: microbiology, bacteriology, zoology, physiology/anatomy, biochemistry, combined general and biological sciences; chamistry, combined biological and physical services, other pure sciences, biological sciences, physics	XXII	874
Accountancy and legal	Accountancy, private practice	XXII	871
	Legal profession	XXII	873
Commerce	Other commerce	XX XXI	
Cultural organizations, entertainment, etc.	Cultural organizations and entertainment	XXII	879/3,4,5
	Others	XXIII	
Religious organizations	Churches	XXII	875
Sectors partly covered by the survey			
Mining and quarrying	National Coal Board and other mining and quarrying	II	
Construction and consultants	Builders, contractors, civil engineers and architects	XVII	879/1
Government and research	Home Civil Service and Diplomatic Service	XXIV	901
	Armed services		
	Atomic Energy Authority		
	Industrial research associations	XXII	879/2
Local authorities	Local government authorities, less subjects in medical services (as above)	XXIV	906
Public utilities and transport	Public utility and transport undertakings	XVIII XIX	

Sources: University Grants Committee
Ministry of Technology

23 Definitions of sectors

The definitions of the industry groups used in this report are given below in terms of the SIC, 1958 revised.

	SIC revised 1958	
	Order	MLH
Menufecturing		
Food, drink end tobacco	III	211-240
Chemicals end allied industries (excluding minerel oil refining)	IV	281, 263-277
Mineral oil refining	IV	262
Metel manufecture	V	311-322
Mechenicel engineering	VI	331-339, 341, 342, 349 351, 352,
	and IX	391-399
Mechine tools	VI	322, 333
Scientific instrumenta	VI	361, 362
Other mechanicel engineering	VI and IX	331, 334-339, 341, 342, 349, 391-399
Electrical engineering	VI	381, 362, 366, 369
Electronics	VI	363, 364
Aircreft	VIII	383
Motor vehicles	VIII	381, 382, 389
Other vehicles of which :	VII end VIII	370, 384, 386
Shipbuilding and marine engineering	VII	370
Textiles, clothing, etc.	X, XI and XII	411-429 431-433 441-450
Other manufecturing	XIII	461-469
	XIV	471-479
	XV	481-489
	XVI	491-499
Accountancy and legal services	XXII	871, 873
Agriculture	I	001-003
Commerca	XX end XXI	810-832, 860
Educetion	XXII	872
Government end research	XXII end XXIV	879/2, 901
Local authorities end construction	XVII end XXIV	500, 908
Medical services	XXII	874
Mining and quarrying	II	101-109
Other	XXII and XXIII	875, 879/3-5, 881-899
Public utilities of which :	XVIII and XIX	601-603, 701-709
Ges	XVIII	601
Electricity	XVIII	602
Scientific end technical services	XXII	879/1

References

(1) *Census 1961, Great Britain, Scientific and Technological Qualifications.* General Register Office, General Registry Office, Scotland (HMSO) 1962.

(2) *Census 1961, England and Wales, Industry Tables Part I.* General Register Office (HMSO) 1966.

(3) *Census 1966, Great Britain, Scientific and Technological Qualifications,* Office of Population Censuses and Surveys, General Registry Office, Scotland (HMSO) 1971.

(4) *Scientific and Engineering Manpower in Great Britain.* Office of the Lord President of the Council, Ministry of Labour and National Service (HMSO) 1956.

(5) *Scientific and Technological Manpower in Great Britain 1962* (HMSO) Cmnd 902 November 1959.

(6) *Scientific and Technological Manpower in Great Britain 1962* (HMSO) Cmnd 2146 October 1963.

(7) *Report on the 1965 Triennial Manpower Survey of Engineers, Technologists, Scientists and Technical Supporting Staff* (HMSO) Cmnd 3103 October 1966.

(8) *The Brain Drain. Report of the Working Group on Migration.* Committee on Manpower Resources for Science and Technology (HMSO) Cmnd 3147 October 1967.

(9) *Employment and Productivity Gazette.* Department of Employment and Productivity—monthly.

(10) *The Survey of Professional Engineers 1968* (A joint survey by the Ministry of Technology and Council of Engineering Institutions) (HMSO) 1970.

(11) *The Survey of Professional Scientists 1968* (A joint survey by the Ministry of Technology and the Council of Science and Technology Institutes) (HMSO) 1970.

(12) *First employment of University Graduates.* University Grants Committee (HMSO)—annually

(13) *Standard Industrial Classification. Revised 1958.* Central Statistical Office (HMSO) 1958.

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Persons with Qualifications in Engineering, Technology and Science

1959 to 1968

Department of Trade and Industry

Studies in Technological Manpower
No. 3

London, 1971
Her Majesty's Stationery Office

From 20 October 1970 the Department of Trade and Industry assumed the functions of the Ministry of Technology in relation to this publication.

This study has been devised and directed by Mrs Joan G Cox, Head of the Scientific and Technological Statistics Branch in the Department of Trade and Industry.

SBN 11 470223 3

Preface

This volume presents for the first time a coherent system of statistics from 1959 to 1968 for persons qualified in engineering, technology and science. It demonstrates how the qualified population has changed over the period, reflecting past and current flows—new supply, migretion and natural wastage.

The new date from the 1966 Census of Populetion and from the 1968 manpower survey ere brought together in the study.

Finally it describes how this system of statistics provides the besic data for e set of manpower models for the 400 000 quelified persons in Great Britein.

Acknowledgements

The coherent system of statistics for persons qualifiad in angineering, technology and science in Graat Britain described in this volume has bean made possible by the collaboration of many companies, public bodies, research establishments, professional institutions and privata individuals over a considerabla period of years.

The Department of Trade and Industry would like to thank all the companies in manufacturing and construction, the firms of consultants, industrial research associations, private laboratories and the public corporations who have responded not only to the 1968 survey but to the earlier surveys in this series. The Department would also like to thank the Department of Employment, the Office of Population Censuses and Surveys, the University Grants Committee, the Central Statistical Office, Department of Education and Science and other Government departmants who have not only provided data for the surveys but hava given invaluable advice on methodology. Finally, thanks are also due to the Council of Engineering Institutions, the Council of Science end Technology Institutes and the twenty-four professional institutions who hava contributed data on an annual basis since 1956.

Without the generous assistance of all who have contributed in one form or another, this study of qualified manpower could naver have been completed.

Sciantific and Technological Statistics Branch
Departmant of Trada and Industry

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Introduction

This survey of professional scientists and applied scientists is the most comprehensive that has so far been undertaken in the United Kingdom, and gives a detailed statistical picture of the activities and earnings of more than twenty-five thousand scientists, irrespective of their different disciplines and specialized interests. It shows how this country makes use of one of its most valuable assets—the qualified biologists, chemists, mathematicians, metallurgists and physicists who make up its scientific manpower.

For the purpose of the survey, a professional scientist was defined as any person who, on 1st April 1966, was a Fellow; an Associate Fellow, Associate or Member; a Licentiate; or a Graduate member of one of the following qualifying bodies:

The Institute of Biology
The Royal Institute of Chemistry
The Institute of Mathematics and its Applications
The Institution of Metallurgists
The Institute of Physics and The Physical Society

There are, of course, other societies that award qualifications in specialized branches of science and technology, but the majority of scientists belong to one or other of the five major Institutes named above, whether they are members of other bodies or not. The scope of the survey was, therefore, sufficiently wide to be representative of professional scientists in the United Kingdom.

In other contexts a university degree in science, or an equivalent to such a degree, has been regarded as the minimum standard of attainment required for designation as a professional scientist. The members of the five institutes have all reached this standard and seventy per cent hold university degrees as well as a professional qualification.

Traditionally, the academic level for admission to the five science institutes has corresponded very closely to that of a degree *with first or second class honours*, and the great majority of Fellows and Associates, or their equivalent, who make up more than 69 per cent of the membership surveyed, have reached this 'good honours degree' level. The separate statistics relating to the remuneration of all members, regardless of grade, and that of Fellows and Associates only are therefore of special significance.

In the past, the individual science institutes have conducted separate surveys of the remuneration of their members at different times and in diverse forms. However, in 1967 it was agreed that the next survey should be carried out simultaneously as a joint exercise and in standard form. The questionnaire, which asked for much more information than on any previous occasion, was devised in consultation with the Ministry of Technology and is reproduced on pages 40 and 41. Planning and organization of the project was co-ordinated by the office of the Royal Institute of Chemistry but each institute received the completed questionnaires from its own members. Initial processing of the edited questionnaires was undertaken by the Computer Department of the Glaxo Group of companies as a gesture of goodwill. The analysis of results and commentary for the separate surveys have since been published by the five bodies, mainly in their respective journals. These individual surveys are extremely valuable in that they provide material for a study of the relatively small but significant differences in the characteristics of the five groups of scientists.

The total number of scientists invited to answer the questionnaire was nearly 40 000 and 69 per cent responded. All the statistical material of the separate surveys was then passed to the Ministry of Technology for reprocessing in a single exercise. This was designed to provide, for the first time, a profile of professional scientists closely compatible with the profiles of professional engineers, obtained from the surveys carried out in 1966 and again in 1966. These surveys were undertaken jointly by the Ministry and the Council of Engineering Institutions.

The Council of Science and Technology Institutes

The Council of Science and Technology Institutes (CSTI) was established in February 1969, with the five bodies previously referred to as founder members.

The objects of the Council are:

(a) to make known as widely as possible the part that science and technology play in a modern community and to represent and enhance the

contribution of the scientist and technologist to the well-being of every citizen,

(*b*) to be a channel for the communication of common views of the member societies to Government departments, to industry and to other organizations (in particular the Royal Society and the Council of Engineering Institutions),

(*c*) to collect information necessary for the formulation of common views,

(*d*) to make available to members of all the constituent bodies the privilege of attending meetings arranged by any one body at the same rate as charged to members of that body,

(*e*) to provide joint services for members,

(*f*) to aim at the adoption of common, easily understood terminology indicating levels of qualifications,

(*g*) to collaborate on matters of educational policy, especially recruitment to the professions,

(*h*) to collaborate on other matters of common concern.

Profiles of professional scientists and engineers

It has been agreed with the Council of Engineering Institutions that reciprocal publication of data on the remuneration of scientists and engineers would be of considerable interest.

The charts and table on pages 18 and 19 showing median incomes by age-group have been prepared jointly by the two bodies to illustrate the similarities and differences between the profiles of professional scientists and engineers.

Part one Charts and summary tables

Age distribution of scientists

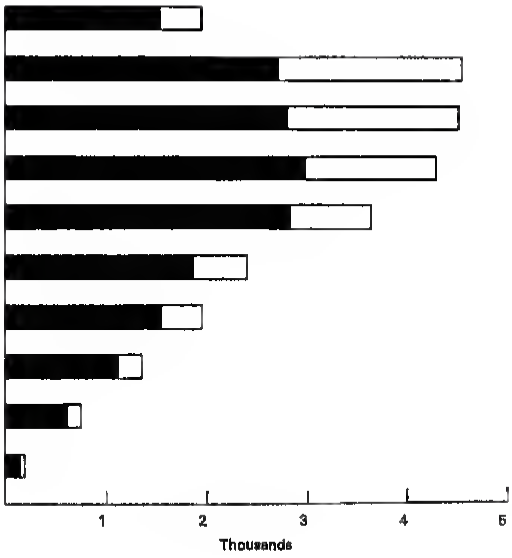


Table 1	Sample number	Per cent
All scientists	25 560	100·0
Under 25	1 953	7·6
25 — 29	4 565	17·9
30 — 34	4 535	17·7
35 — 39	4 282	16·8
40 — 44	3 634	14·2
45 — 49	2 395	9·4
50 — 54	1 945	7·6
55 — 59	1 342	5·3
60 — 64	735	2·9
65 and over	173	0·7

■ University graduates

About three-quarters of scientists were under 45; about one-third were in the age group 35-44. This latter group represents a distinct feature of the growth as compared with the 10-year group, 45-54, ahead of them.

● See also Tables 10 to 18

Class of employer

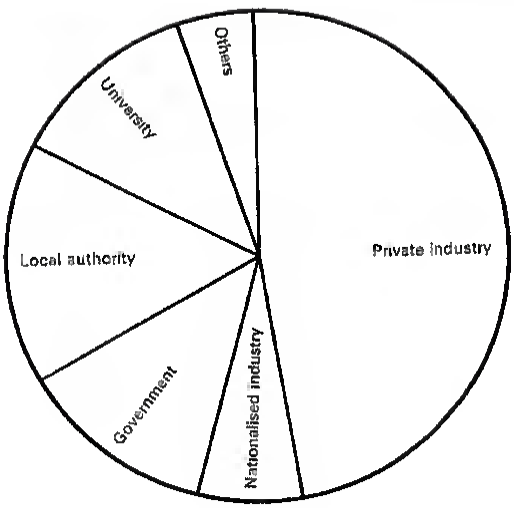


Table 2	Sample number	Per cent
All scientists	**25 560**	
Scientists stating employer	**25 564**	**100·0**
Self-employed	249	*1·0*
Employed by—		
Industrial or commercial company or private firm	12 223	*47·8*
Nationalized industry or public corporation	1 662	*6·6*
Central Government and Armed Forces	2 371	*9·3*
Hospital Board	246	*1·0*
The UK Atomic Energy Authority	866	*3·4*
Local authority, including colleges and schools	4 036	*15·8*
University	3 166	*12·3*
Other employer	735	*2·9*

The overwhelming majority of scientists are employees, with only one per cent self-employed. Nearly half (48 per cent) are scientists employed by private industry and commerce. Smaller but still important employers are local authorities (16 per cent), Central Government, including the Armed Forces and UKAEA (13 per cent) and universities (12 per cent).

● See also Tables 10, 21 and 22

Type of work

The distribution of scientists by type of work is shown in this chart. The shaded areas represent those who stated that they held an administrative or managerial position, whether this is scientific or non-scientific work.

Research and development was the most frequently observed type of work, nearly 36 per cent of the total. Teaching was the second largest group, a quarter of all the scientists.

More than half of the scientists stated that they held administrative or managerial positions, and of these 46 per cent were in the combined group of research and development, and general technical administration. The non-managerial posts are dominated by research and development and teaching, which together form 76 per cent of the group.

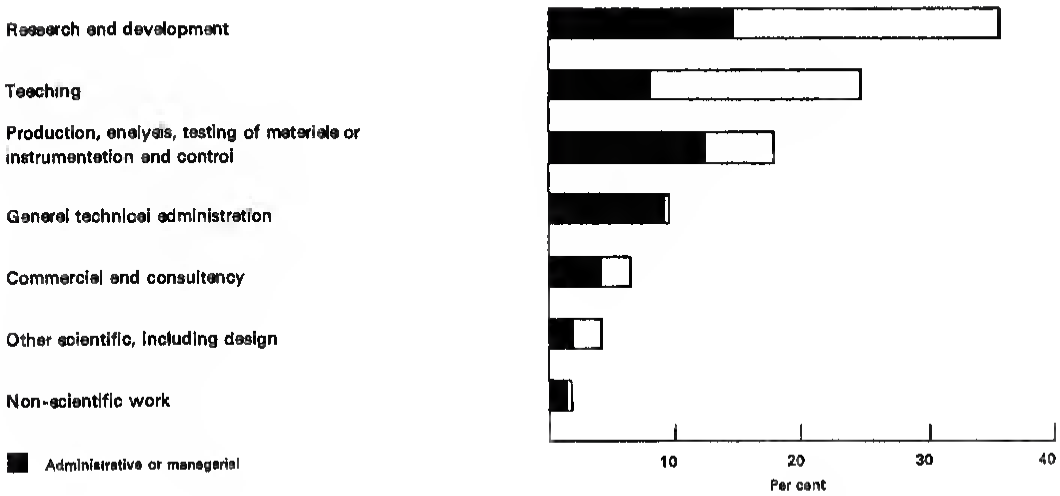


Table 3	Sample number		In managerial positions		In other positions	
		Per cent	Number	Per cent	Number	Per cent
All scientists	26 560		13 386		12 194	
Scientists stating type of work	26 509	100·0	13 324	100·0	12 186	100·0
Research and development	9 073	*35·5*	3 772	*28·3*	6 301	*43·5*
Teaching	6 342	*24·9*	2 122	*15·9*	4 220	*34·5*
Analysis, testing of materials or instrumentation and control	2 652	*10·4*	1 489	*11·2*	1 163	*9·5*
Production	1 835	*7·2*	1 648	*12·4*	187	*1·5*
General technical administration	2 383	*9·3*	2 336	*17·6*	47	*0·4*
Technical services, sales or similar commercial work	1 162	*4·6*	794	*5·0*	368	*3·0*
Consultancy	460	*1·8*	306	*2·3*	154	*1·3*
Design	216	*0·8*	100	*0·8*	116	*1·0*
Other scientific work	977	*3·8*	408	*3·1*	568	*4·7*
Non-scientific work	409	*1·6*	348	*2·6*	61	*0·5*

● See also Tables 8, 11 to 13, 20 and 22

Field of employment

The chart below shows the distribution of scientists according to their field of employment, using wide groupings. The more detailed breakdown shown opposite is based on the Standard Industrial Classification.

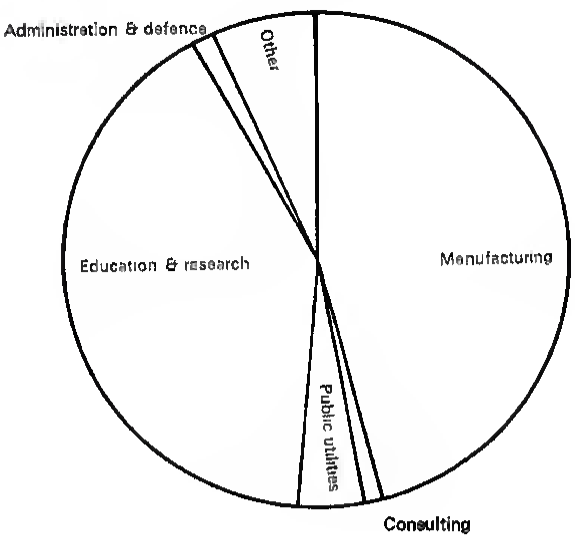
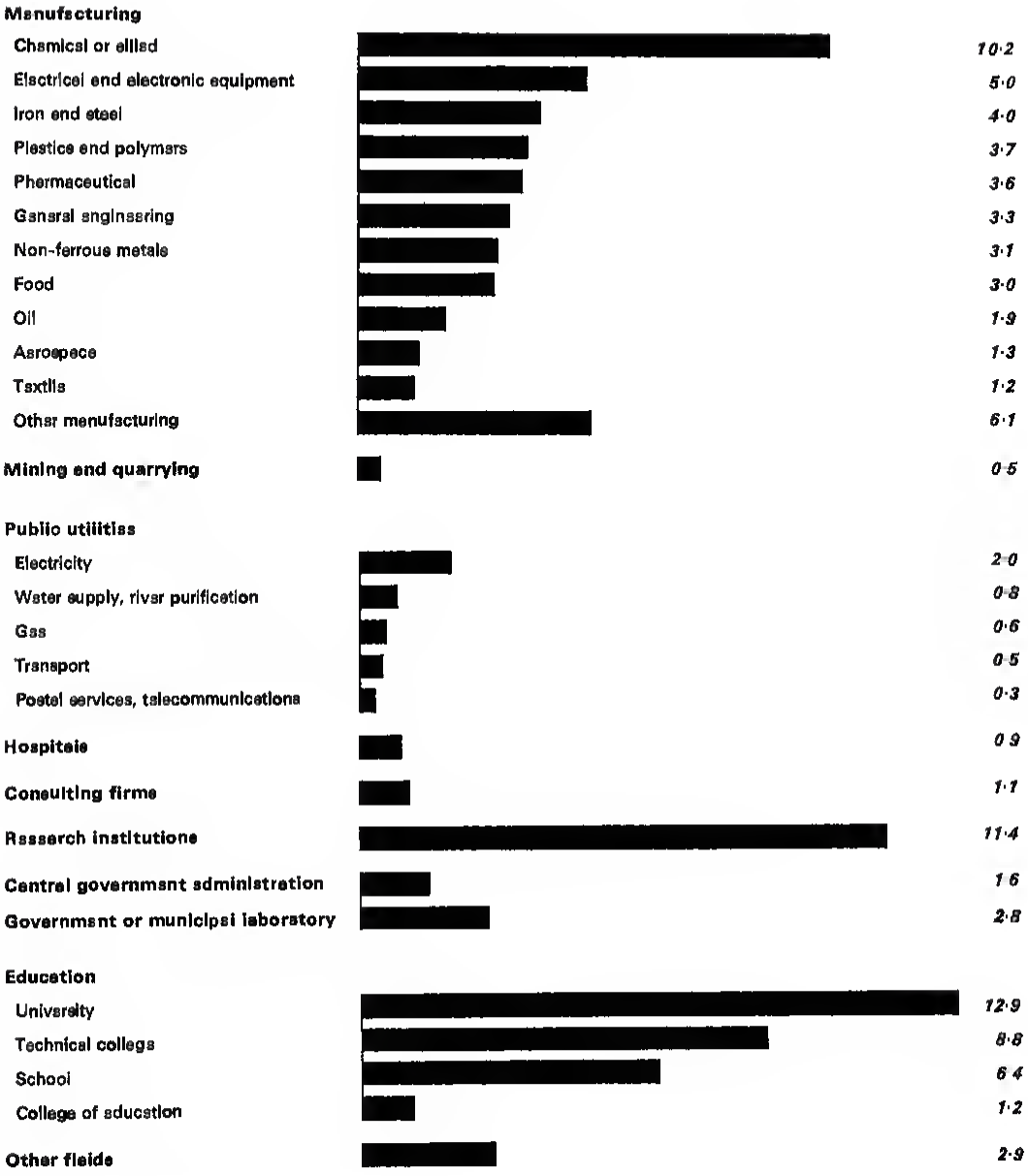


Table 4	Sample number	Per cent
All scientists	**25 560**	
Scientists stating field	**25 532**	**100·0**
Manufacturing	11 852	*45·6*
Mining and quarrying	131	*0·5*
Gas, electricity and water	870	*3·4*
Transport and communications	181	*0·7*
Hospitals	234	*0·9*
Research institutions	2 908	*11·4*
Education	7 455	*29·2*
Central Government administration	373	*1·5*
Government or municipal laboratory	718	*2·8*
Consulting firms	281	*1·1*
Other fields	729	*2·9*

● See also Tables 14, 20 and 21

Perosntegs of all scientiste who etatsd fieid of employmsnt

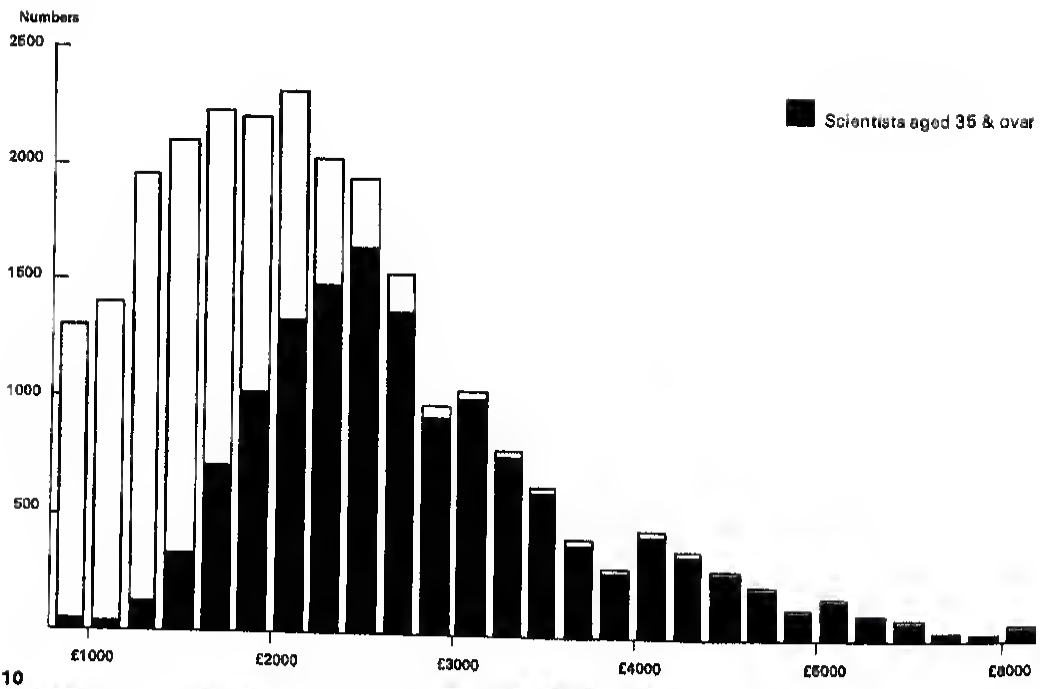


Distribution of incomes — all scientists

This chart, and the one on the next page, analyses the incomes of all scientists in the sample, by age.

If two groups are considered, those scientists under 35 years old and those 35 years and over, the distributions of incomes for the two groups differ markedly. This difference is illustrated by the chart on this page. It shows that almost all of the under 35 year old scientists earn less than £2 500 per annum. Only 40 per cent of the older group earn less than £2500 per annum.

The next page has a chart showing the median income by age, and the dispersion about the median, measured by the quartiles and the highest and lowest deciles.



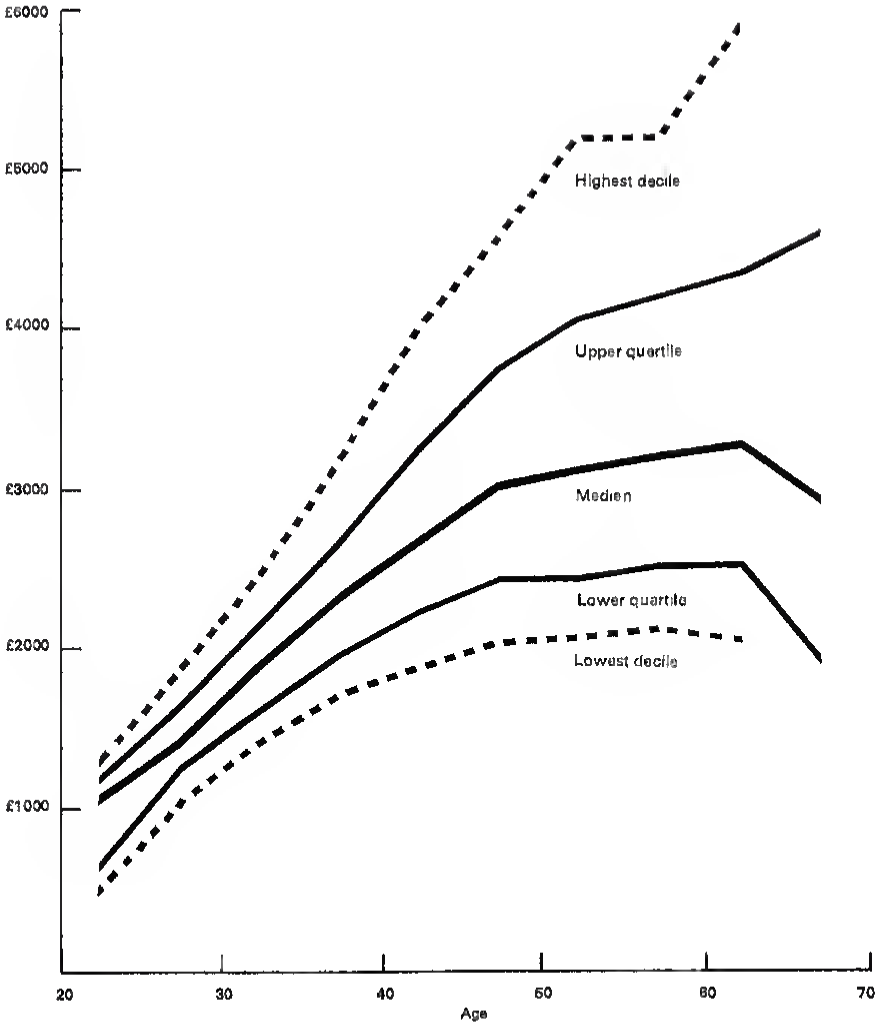


Table 5	Lowest decile	Lower quartile	Median	Upper quartile	Highest decile
	£	£	£	£	£
All ages	1 177	1 558	2 143	2 674	3 931
Under 25	500	651	1 050	1 190	1 310
25 — 29	1 020	1 210	1 400	1 630	1 850
30 — 34	1 406	1 600	1 675	2 150	2 430
35 — 39	1 700	1 950	2 295	2 560	3 171
40 — 44	1 862	2 240	2 652	3 250	4 000
45 — 49	2 020	2 440	3 000	3 750	4 600
50 — 54	2 039	2 433	3 107	4 051	5 200
55 — 59	2 100	2 500	3 176	4 200	5 200
60 — 64	2 037	2 500	3 255	4 310	5 928
65 and over	*	1 893	2 905	4 808	*

* Numbers in these groups are too small to justify calculation of deciles

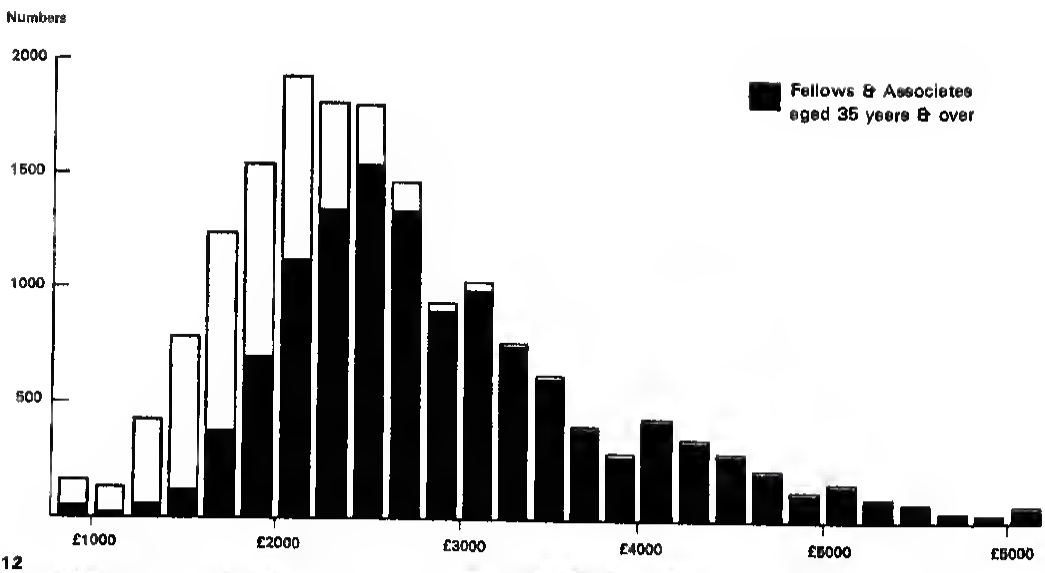
● See also Tables 15 to 19

Distribution of incomes— fellows and associates

Fellows and Associates of the institutes replying to the questionnaire formed 69 per cent of the total sample of scientists. When an analysis of these higher membership grades is made, similar to that of the two previous pages, some interesting differences appear. As might be expected, there are proportionately fewer of the Fellows and Associates under 35 years old. This younger age group still earns, in the great majority of cases, less than £2 500 per annum, but of the 73 per cent who are over 35 years old 65 per cent earn more than £2 500 per annum.

The medians, quartiles and deciles of the chart on the next page show that incomes at all levels of Fellows and Associates are higher than for the whole sample at the same age.

The regulations of the institutes vary but, in general, it is not possible to obtain election to the grade of Fellow or Associate before the age of 25; the exception is that of the Royal Institute of Chemistry. The chart has, therefore, been drawn without this lower age group



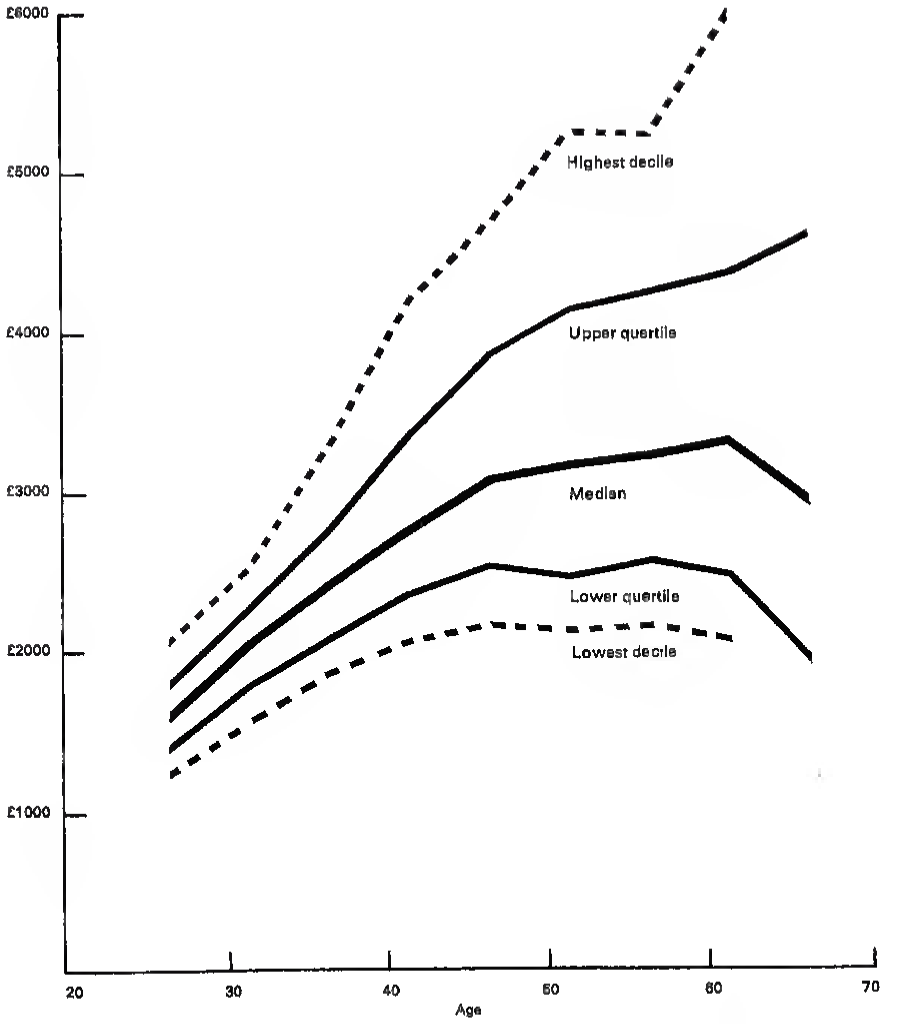


Table 6	Lowest decile	Lower quartile	Median	Upper quartile	Highest decile
	£	£	£	£	£
All ages	**1 641**	**2 012**	**2 489**	**3 196**	**4 259**
Under 25	*	*	1 107	*	*
25 — 29	1 210	1 388	1 593	1 798	2 051
30 — 34	1 551	1 758	2 015	2 267	2 544
35 — 39	1 841	2 068	2 410	2 768	3 299
40 — 44	2 041	2 383	2 767	3 360	4 199
45 — 49	2 150	2 524	3 067	3 831	4 877
50 — 54	2 119	2 488	3 155	4 126	5 246
55 — 59	2 131	2 553	3 207	4 242	5 240
60 — 64	2 054	2 488	3 302	4 364	5 992
65 and over	*	1 920	2 933	4 600	*

* Numbers in these groups are too small to justify the calculation of quartiles and deciles

● See also Table 1a

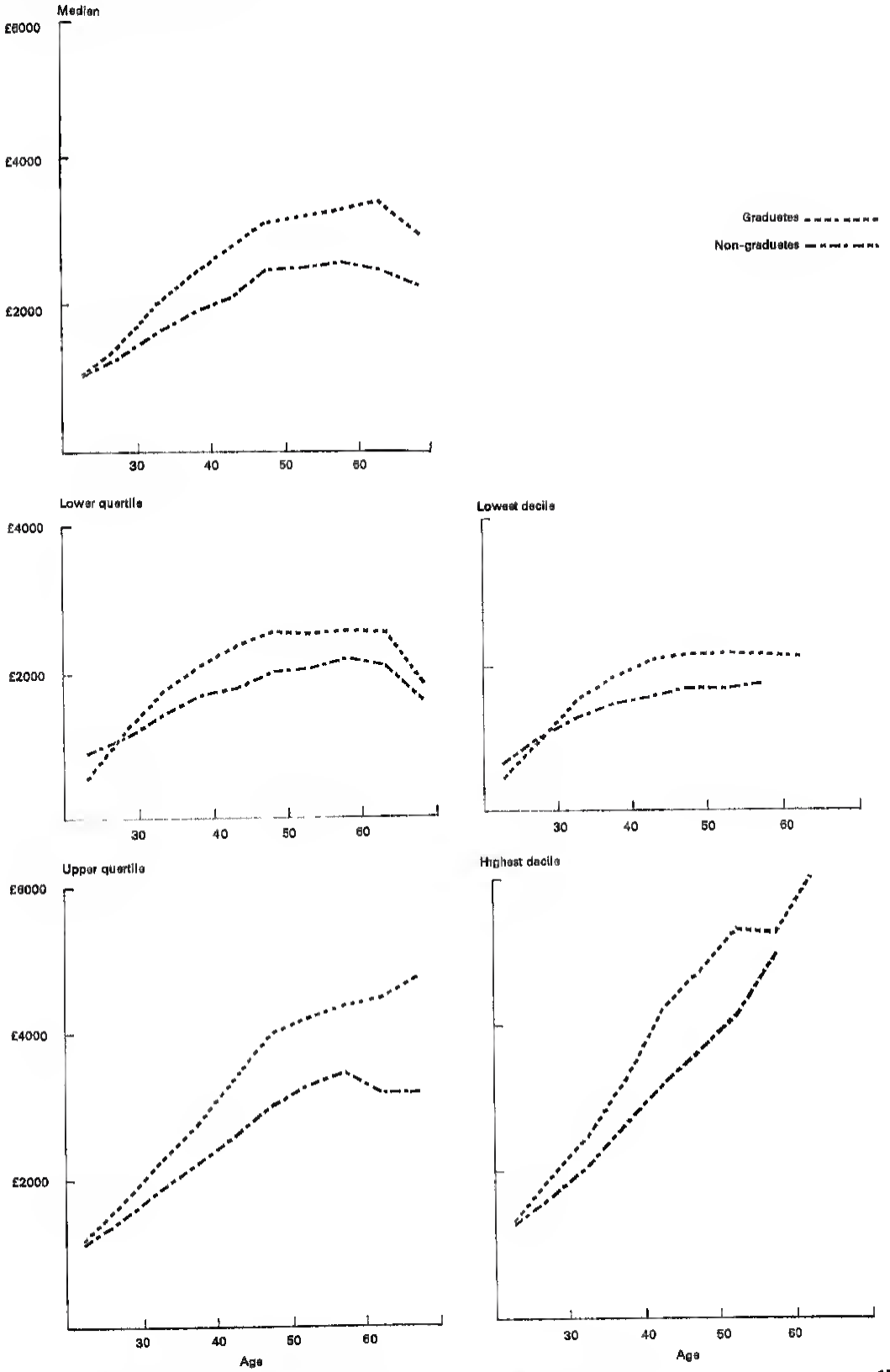
Distribution of incomes of graduates and non-graduates

The income distribution of scientists is shown, distinguishing between university graduates and non-graduates. The incomes are given as a frequency distribution, and also in a cumulative form. The tables show that over two-thirds of the non-graduate scientists earn less than £2 000, but two-thirds of the graduates earn more than £2 000. The charts opposite show the medians, quartiles and decilas for graduates and non-graduates.

Table 7	Distribution		Cumulative	
	Number	Per cent	Number	Per cent
UNIVERSITY GRADUATES				
All scientists	18 069	100·0		
£6 000 and above	415	*2·3*	415	*2·3*
£5 000 — 5 999	380	*2·1*	795	*4·4*
£4 000 — 4 999	1 347	*7·5*	2 142	*11·9*
£3 000 — 3 999	2 741	*15·2*	4 993	*27·1*
£2 000 — 2 999	6 930	*38·3*	11 813	*65·4*
£1 000 — 1 999	5 294	*29·1*	17 077	*94·5*
Below £1 000	992	*5·5*	16 069	*100·0*
NON-GRADUATES				
All scientists	7 491	100·0		
£6 000 and above	46	*0·6*	46	*0·6*
£5 000 — 5 999	47	*0·6*	93	*1·2*
£4 000 — 4 999	103	*1·4*	196	*2·6*
£3 000 — 3 999	433	*5·8*	629	*8·4*
£2 000 — 2 999	1 844	*24·6*	2 473	*33·0*
£1 000 — 1 999	4 702	*62·8*	7 175	*95·8*
Below £1 000	316	*4·2*	7 491	*100·0*

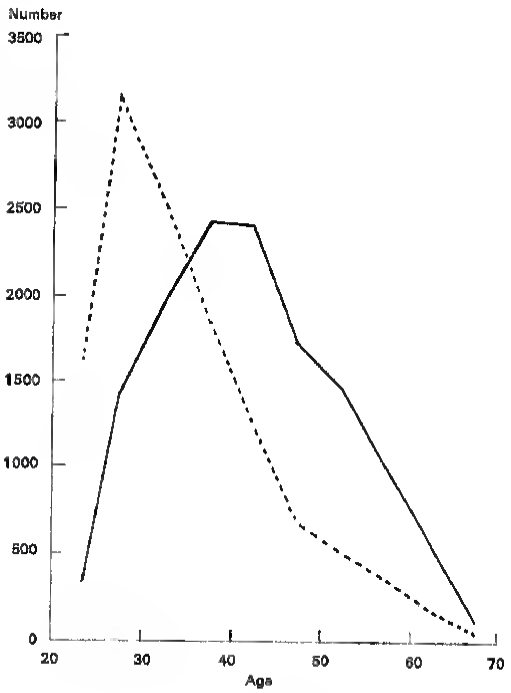
a See also Tables 16 and 17

Comparison of incomes of university or CNAA gredustes and non-graduates



Managerial posts by age

All scientists were asked to classify themselves as either administrative or managerial, or otherwise. The charts below show how the incidence of managerial status rises with increasing age of scientists. The chart showing percentages illustrates this clearly. It can be seen that after about 35 years of age, more than half of the scientists are in managerial posts in each age group.



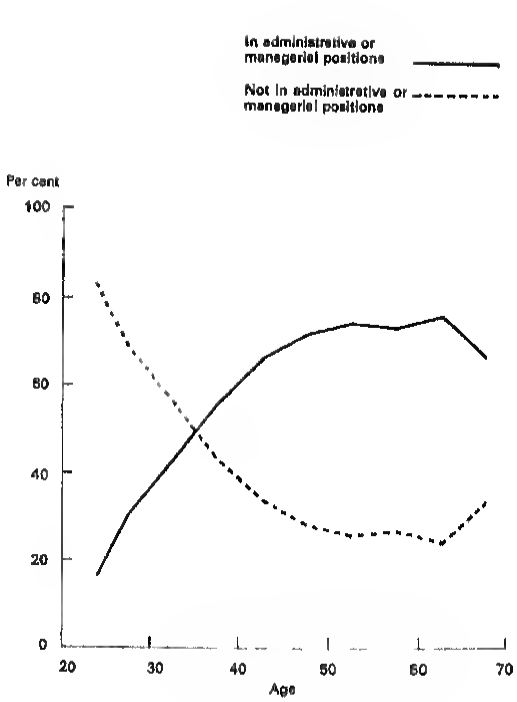


Table 9	Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
In administrative or managerial posts	329	1 413	1 988	2 426	2 411	1 721	1 444	982	557	115
Not in administrative or managerial posts	1 824	3 152	2 567	1 856	1 223	674	502	360	178	58
Per cent	%	%	%	%	%	%	%	%	%	%
In administrative or managerial posts	*16·8*	*31·0*	*43·4*	*56·7*	*66·3*	*71·9*	*74·2*	*73·2*	*75·8*	*66·5*
Not in administrative or managerial posts	*83·2*	*69·0*	*56·6*	*43·3*	*33·7*	*28·1*	*25·8*	*26·8*	*24·2*	*33·5*

Incomes of scientists and engineers 1968

The charts and table ovarlaaf hava been prepared jointly by the Council of Sclance and Technology Institutes and the Council of Engineering Institutions to illustrate tha similarities and differences between the profiles of professional acientists and engineers.

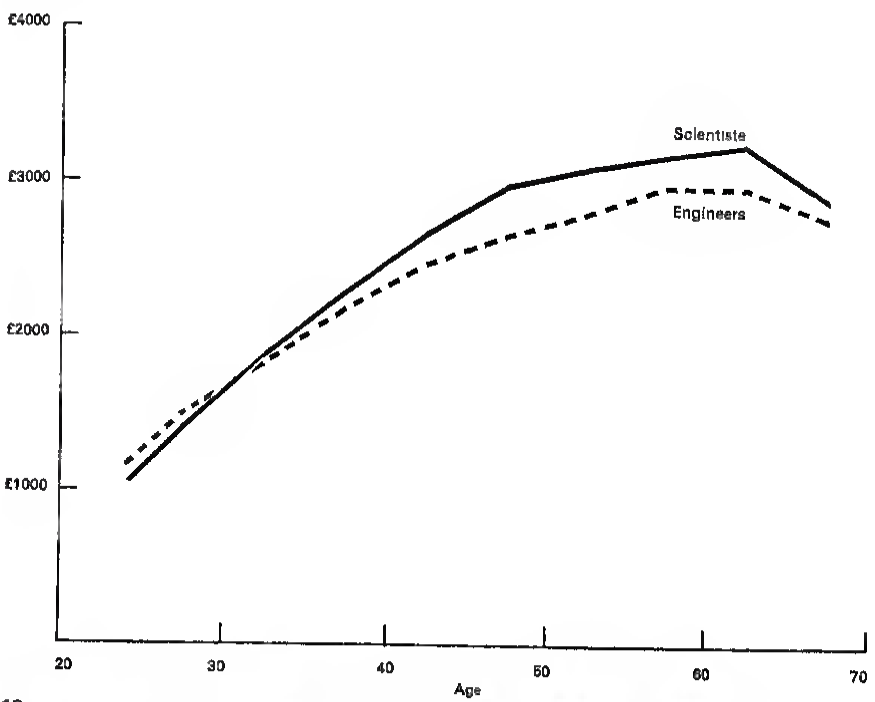
In 1968 there were parallel surveys of scientists and of engineers who were members of one of their professional institutions.

These charts and the accompanying tables have been prepared to illustrate the similarities and differences which have been shown to exist. Earlier surveys of both scientists and engineers have shown that those with university or CNAA degrees earn rather more than those without. Thus, in making a comparison of median incomes of scientists and engineers, it is important to note that those with degrees were 71 per cent of the sample of scientists but only 38 per cent of the sample of engineers. This accounts for the change in the relative position of the curves shown in the three charts.

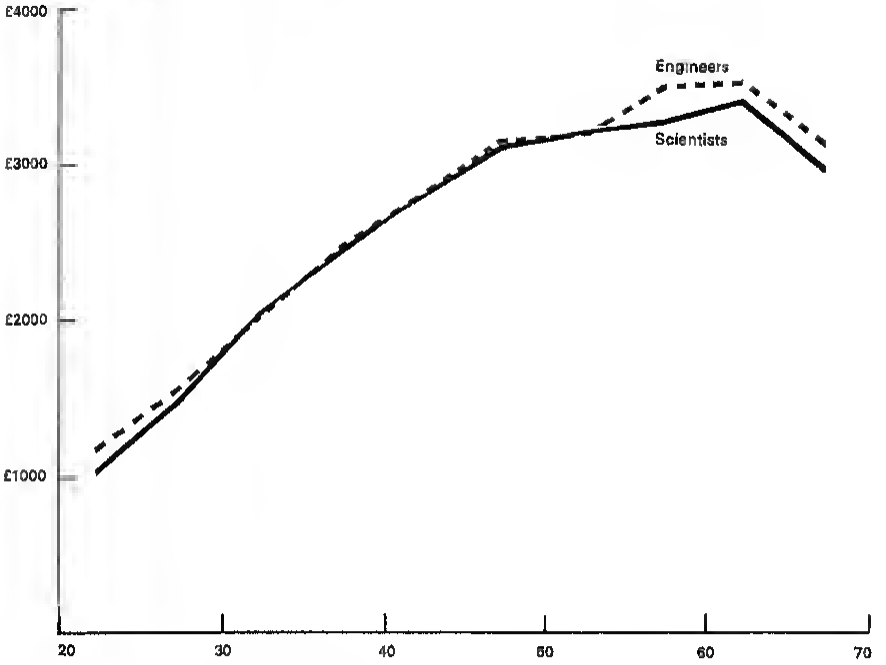
The upper chart on the opposite page shows how closely the median incomes of scientists and engineers with degrees are related. The age group 65-69 appears to be the only one for which the engineer has a significant lead over the scientist of a corresponding age.

The third chart shows that the non-graduate scientists have a lower median income than non-graduate engineers. This is explained by historical differences in the method of education and training in the two professional groups. In the past professional engineers did not require a university degree. Although the position is now changing, the present body of non-graduate engineers has amongst its members many senior members of the profession. On the other hand the non-graduate scientists are mainly in supporting roles.

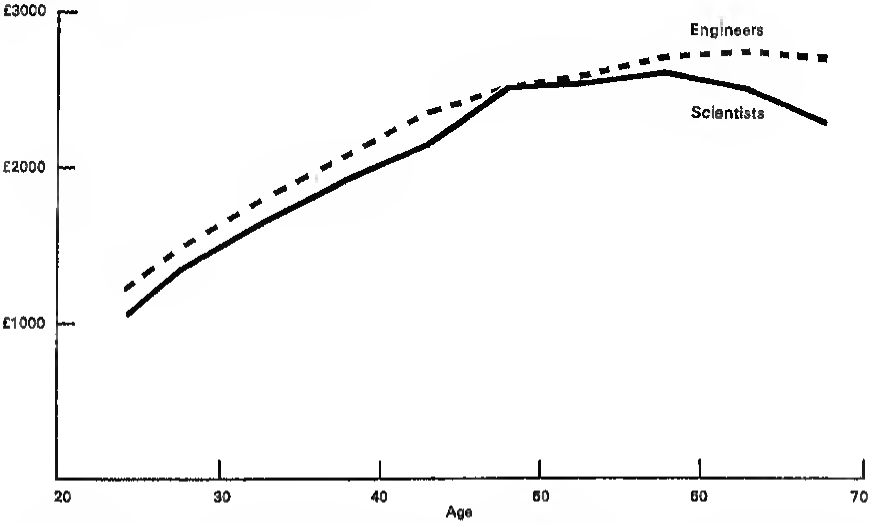
Median incomes of all scientists and engineers in the two surveys



With a university or CNAA degree



Without a university or CNAA degree



Median incomes by age

Table 9	Under 25	25-29	30-34	35-39	40-44	45-48	50-54	55-59	60-64	65 and over
	£	£	£	£	£	£	£	£	£	£
All in sample										
Scientists	1 050	1 400	1 875	2 295	2 652	3 000	3 107	3 176	3 255	2 905
Engineers	1 151	1 500	1 869	2 155	2 500	2 555	2 800	3 000	3 000	2 759
With a university or CNAA degree										
Scientists	1 050	1 455	2 011	2 430	2 500	3 107	3 210	3 290	3 423	3 000
Engineers	1 194	1 537	2 009	2 455	2 800	3 150	3 204	3 500	3 522	3 157
Without a university or CNAA degree										
Scientists	1 057	1 320	1 840	1 913	2 132	2 500	2 537	2 513	2 500	2 300
Engineers	1 130	1 485	1 500	2 052	2 340	2 500	2 603	2 704	2 730	2 692

Part two

ALL SCIENTISTS IN SAMPLE

Analysis by class of employer and age

Table 10

	TOTAL		Age groups									
			Under 25	26-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
ALL SCIENTISTS	**25 560**		**1 953**	**4 565**	**4 535**	**4 282**	**3 634**	**2 395**	**1 946**	**1 342**	**735**	**173**
		%	*7·6*	*17·9*	*17·7*	*16·8*	*14·2*	*9·4*	*7·6*	*5·3*	*2·9*	*0·7*
Self-employed	**249**	**1·0**	**6**	**11**	**18**	**23**	**27**	**27**	**34**	**30**	**28**	**48**
Employed by—												
Central Government and Armed Forces	2 371	*9·3*	194	315	349	371	328	271	267	176	89	11
Hospital Board	245	*1·0*	23	29	27	52	44	28	20	15	6	1
Local authority, including colleges and schools	4 036	*15·8*	190	669	914	805	518	315	289	216	108	12
Nationalized industry or public corporation	1 682	*6·6*	164	399	331	237	212	119	102	73	41	4
The UK Atomic Energy Authority	858	*3·4*	34	92	158	216	145	106	62	34	11	—
University	3 155	*12·3*	328	584	532	478	474	319	177	138	98	27
Industrial or commercial company or private firm	12 223	*47·8*	948	2 343	2 074	1 985	1 794	1 149	943	609	321	57
Any other employer	735	*2·9*	64	123	134	115	92	60	51	50	33	13
Employer not stated	**6**		**3**	—	—	—	—	**1**	**1**	**1**	—	—

ALL SCIENTISTS IN SAMPLE

Analysis by type of work and age

Table 11

	TOTAL		Age groups									
			Under 26	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
ALL SCIENTISTS	**25 560**		**1 953**	**4 565**	**4 535**	**4 282**	**3 634**	**2 395**	**1 946**	**1 342**	**735**	**173**
		%	*7·6*	*17·9*	*17·7*	*16·8*	*14·2*	*9·4*	*7·6*	*5·3*	*2·9*	0·7
General technical administration	2 383	*9·3*	32	180	274	363	446	341	324	254	150	19
Production	1 835	*7·2*	93	300	330	336	266	206	168	86	39	11
Analysis, testing of materials, or instrumentation and control	2 852	*10 4*	162	588	490	429	375	208	189	131	71	9
Research and development	9 073	*35·6*	1 132	2 044	1 557	1 417	1 130	711	556	322	177	27
Design	216	*0·8*	27	39	33	31	31	19	22	12	2	—
Teaching	6 342	*24·9*	206	887	1 379	1 267	960	618	443	355	190	37
Technical service or sales, or similar commercial work	1 162	*4·6*	73	217	221	210	182	105	79	48	20	7
Consultancy, if not covered in one of the other categories	460	*1·8*	35	61	53	54	50	63	39	39	31	45
Other scientific occupation	977	*3·8*	166	193	156	122	118	80	60	52	23	9
Non-scientific occupation	409	*1·6*	27	63	36	43	85	40	59	39	28	9
Type of work not stated	**51**		—	3	**6**	**10**	**13**	4	**7**	4	4	—

Analysis by type of work and age

Table 12

	TOTAL		Age groups									
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
SCIENTISTS IN AOMINISTRATIVE OR MANAGERIAL POSITIONS	**13 366**		**329**	**1 413**	**1 969**	**2 428**	**2 411**	**1 721**	**1 444**	**982**	**557**	**115**
		%	*2·5*	*10 6*	*14·7*	*18·2*	*18 0*	*12·9*	*10 8*	*7·3*	*4·2*	*0·9*
General technical administretion	2 336	*17·5*	30	177	266	352	440	338	319	250	145	19
Production	1 648	*12·4*	67	240	280	310	252	205	164	82	37	11
Analysis, testing of materials, or Instrumentation and control	1 489	*11·2*	44	201	244	263	273	158	142	100	56	8
Research and development	3 772	*28·3*	89	414	550	730	718	504	398	222	132	15
Design	100	*0·8*	2	9	18	15	19	10	18	8	1	—
Teaching	2 122	*15·9*	24	143	344	441	378	281	212	178	104	17
Technical service or sales, or similar commercial work	794	*6·0*	23	110	132	168	151	84	64	40	17	5
Consultancy, if not covered in one of the other categones	306	*2·3*	8	23	38	38	40	53	26	30	22	30
Other scientific occupation	409	*3·1*	27	52	62	58	69	51	39	30	18	5
Non-scientific occupation	348	*2·6*	15	42	33	42	61	34	55	38	23	5
Type of work not stated	**42**		**—**	**2**	**3**	**9**	**10**	**3**	**7**	**4**	**4**	**—**

SCIENTISTS IN SAMPLE NOT IN ADMINISTRATIVE OR MANAGERIAL POSITIONS

Analysis by type of work and age

Table 13

	TOTAL		Age groups									
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
SCIENTISTS NOT IN ADMINISTRATIVE OR MANAGERIAL POSITIONS	**12 194**		**1 624**	**3 152**	**2 567**	**1 856**	**1 223**	**674**	**502**	**360**	**178**	**58**
		%	*13·3*	*25·8*	*21·1*	*15·2*	*10·0*	*5·5*	*4·1*	*3·0*	*1·5*	*0·5*
General technical administration	47	*0·4*	2	3	8	11	6	3	5	4	5	—
Production	187	*1·5*	26	60	50	26	14	1	4	4	2	—
Analysis, testing of materials, or instrumentation and control	1 163	*9·5*	118	387	246	166	102	50	47	31	15	1
Research and development	5 301	*43·5*	1 043	1 630	1 007	687	412	207	158	100	45	12
Design	116	*1·0*	26	30	15	16	12	9	4	4	1	—
Teaching	4 220	*34·6*	162	744	1 035	826	582	337	231	177	86	20
Technical service or sales, or similar commercial work	368	*3·0*	60	107	89	42	31	21	15	8	3	2
Consultancy, if not covered in one of the other categories	154	*1·3*	27	28	17	16	10	10	13	9	9	15
Other scientific occupation	568	*4·7*	139	141	94	64	47	29	21	22	7	4
Non-scientific occupation	61	*0·5*	12	21	3	1	4	6	4	1	6	4
Type of work not stated	**9**		—	1	3	1	3	1	—	—	—	—

Analysis by field of employment and age

Table 14

	TOTAL		Age groups									
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
ALL SCIENTISTS	**25 560**		**1 953**	**4 565**	**4 535**	**4 282**	**3 634**	**2 395**	**1 946**	**1 342**	**735**	**173**
		%	*7·6*	*17·9*	*17·7*	*16·8*	*14·2*	*9·4*	*7·6*	*5·3*	*2·9*	*0·7*
Manufacturing	11 662	*45·6*	849	2 212	2 003	1 901	1 714	1 116	908	585	304	60
Mining and quarrying	131	*0·5*	8	11	22	20	27	13	10	12	5	3
Gas, electricity and water	870	*3·4*	54	203	193	145	104	80	48	33	27	3
Transport and communications	181	*0·7*	24	31	31	28	19	15	14	17	3	1
Hospitals	234	*0·9*	20	31	26	49	44	26	16	15	6	1
Research institution, association or station	2 908	*11·4*	233	499	493	516	410	283	232	140	89	13
Education	7 455	*29·2*	637	1 273	1 483	1 313	1 012	654	466	372	205	40
Central Government administration	373	*1·5*	3	25	24	43	78	58	78	39	20	5
Government or municipal laboratory*	718	*2·8*	21	123	117	127	100	80	78	49	21	2
Consulting firms	281	*1·1*	19	28	28	43	26	35	31	22	20	29
Other work	729	*2·9*	85	122	109	98	98	51	64	55	35	14
Field not stated	**28**		**—**	**7**	**6**	**3**	**2**	**4**	**1**	**3**	**—**	**2**

* Analytical, testing or service

Analysis by income and age

Table 15

	TOTAL		Age groups									
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
ALL SCIENTISTS	**25 560**		**1 953**	**4 565**	**4 535**	**4 282**	**3 634**	**2 395**	**1 946**	**1 342**	**735**	**173**
		%	*7·6*	*17·9*	*17·7*	*16·8*	*14·2*	*9·4*	*7·6*	*5·3*	*2·9*	*0·7*
Below £1 000	1 308	*5·1*	833	389	32	15	8	3	6	4	5	13
£1 000 — 1 199	1 411	*5·5*	644	651	76	10	8	5	3	2	5	7
£1 200 — 1 399	1 969	*7·7*	369	1 170	298	71	21	10	10	9	8	3
£1 400 — 1 599	2 149	*8·4*	80	1 050	691	183	65	25	20	15	12	8
£1 600 — 1 799	2 235	*8·7*	18	704	803	389	155	64	51	26	15	10
£1 800 — 1 999	2 202	*8·6*	3	336	839	513	267	108	71	40	20	5
£2 000 — 2 499	5 278	*20 6*	4	231	1 425	1 549	898	440	366	223	118	24
£2 500 — 2 999	3 498	*13·7*	—	25	274	989	957	536	357	249	111	20
£3 000 — 3 999	3 174	*12·4*	1	8	72	439	846	695	528	364	201	20
£4 000 — 4 999	1 450	*5·7*	1	1	18	111	297	353	303	234	109	23
£5 000 — 5 999	427	*1·7*	—	—	2	16	59	82	111	81	50	17
£6 000 and over	461	*1·8*	—	—	5	18	53	74	120	95	73	23
	£		£	£	£	£	£	£	£	£	£	£
Lowest decile	1 177		500	1 020	1 406	1 700	1 862	2 020	2 039	2 100	2 037	*
Lower quartile	1 658		651	1 210	1 600	1 950	2 240	2 440	2 433	2 500	2 500	1 893
Median	**2 143**		**1 050**	**1 400**	**1 875**	**2 295**	**2 662**	**3 000**	**3 107**	**3 176**	**3 255**	**2 905**
Upper quartile	2 874		1 190	1 630	2 150	2 660	3 250	3 750	4 051	4 200	4 310	4 609
Highest decile	3 931		1 310	1 850	2 430	3 171	4 000	4 600	5 200	5 200	5 928	*

* Numbers in these groups are too small to justify calculation of deciles

Analysis by income and age

Teble 16

	TOTAL		Age groups									
			Under 26	25-29	30-34	35-39	40-44	45-49	50-54	56-69	60-64	65 and over
GRADUATE SCIENTISTS	**18 069**		**1 513**	**2 700**	**2 802**	**2 975**	**2 818**	**1 859**	**1 539**	**1 096**	**616**	**151**
		%	*8·4*	*14·9*	*15·5*	*16 5*	*15·6*	*10·3*	*8·5*	*6·1*	*3·4*	*0 8*
8elow £1 000	992	*5·5*	669	255	22	14	6	2	6	3	4	11
£1 000 — 1 199	741	*4·1*	461	236	23	2	3	1	3	1	4	7
£1 200 — 1 399	966	*5·3*	296	663	66	17	5	5	3	4	4	3
£1 400 — 1 599	1 011	*5·6*	63	632	219	44	14	9	7	8	9	6
£1 600 — 1 799	1 180	*6·5*	18	512	404	128	50	21	19	13	7	8
£1 800 — 1 999	1 366	*7·6*	2	271	574	260	126	59	37	21	12	4
£2 000 — 2 499	4 047	*22·4*	2	203	1 173	1 160	666	294	271	172	86	20
£2 500 — 2 999	2 883	*16·0*	—	20	243	845	812	400	266	192	90	16
£3 000 — 3 999	2 741	*15·2*	1	7	55	373	751	603	444	316	172	19
£4 000 — 4 999	1 347	*7·5*	1	1	17	103	285	323	278	215	103	21
£5 000 — 5 999	380	*2·1*	—	—	1	12	55	75	97	69	57	14
£6 000 and over	415	*2·3*	—	—	5	17	45	67	108	82	66	23
	£		£	£	£	£	£	£	£	£	£	£
Lowest decile	1 215		500	1 000	1 550	1 881	2 100	2 189	2 200	2 189	2 155	*
Lower quartile	1 737		600	1 265	1 780	2 124	2 395	2 572	2 541	2 615	2 586	1 900
Medien	**2 343**		**1 050**	**1 485**	**2 011**	**2 430**	**2 800**	**3 107**	**3 210**	**3 290**	**3 423**	**3 000**
Upper quartile	3 133		1 200	1 714	2 270	2 779	3 392	3 995	4 201	4 360	4 500	4 800
Highest decile	4 249		1 313	1 950	2 510	3 314	4 218	4 730	6 319	5 250	6 055	*

* Numbers in these groups are too small to justify calculation of deciles

Analysis by income and age

Table 17

	TOTAL		Age groups: Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
NON-GRADUATE SCIENTISTS	**7 491**		**440**	**1 865**	**1 733**	**1 307**	**816**	**536**	**407**	**246**	**119**	**22**
		%	*5·9*	*24·9*	*23·1*	*17·4*	*10·9*	*7 2*	*5·4*	*3·3*	*1·6*	*0·3*
Below £1 000	316	*4·2*	184	134	10	1	2	1	—	1	1	2
£1 000 — 1 199	670	*8·9*	183	415	53	8	5	4	—	1	1	—
£1 200 — 1 399	1 003	*13·4*	73	607	232	54	16	5	7	5	4	—
£1 400 — 1 599	1 136	*15·2*	17	416	472	139	61	16	13	7	3	2
£1 600 — 1 799	1 055	*14·1*	—	192	399	281	105	43	32	13	8	2
£1 600 — 1 999	638	*11·2*	1	65	265	253	141	49	34	19	8	1
£2 000 — 2 499	1 229	*16·4*	2	28	252	369	232	146	95	51	30	4
£2 500 — 2 999	615	*8·2*	—	5	31	124	145	136	91	57	21	5
£3 000 — 3 999	433	*5·8*	—	1	17	66	95	92	84	48	29	1
£4 000 — 4 999	103	*1·4*	—	—	1	8	12	30	25	19	6	2
£5 000 — 5 999	47	*0·6*	—	—	1	3	4	7	14	12	3	3
£6 000 and over	46	*0·6*	—	—	—	1	8	7	12	13	5	—
	£		£	£	£	£	£	£	£	£	£	£
Lowest decile	1 129		700	1 029	1 306	1 500	1 601	1 718	1 708	1 767	*	*
Lower quartile	1 377		912	1 155	1 450	1 708	1 811	2 021	2 082	2 205	2 100	1 630
Median	**1 717**		**1 057**	**1 320**	**1 640**	**1 913**	**2 132**	**2 500**	**2 537**	**2 613**	**2 500**	**2 300**
Upper quartile	2 244		1 189	1 500	1 875	2 240	2 600	3 000	3 300	3 463	3 200	3 200
Highest decile	2 902		1 300	1 676	2 105	2 700	3 202	3 650	4 165	4 964	*	*

* Numbers in these groups are too small to justify calculation of deciles

Analysis by income and age

Table 18

	TOTAL		Age groups									
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
FELLOWS AND ASSOCIATES	17 665		65	1 644	3 027	3 443	3 174	2 220	1 884	1 314	732	172
		%	*0·3*	*9·3*	*17·1*	*19·5*	*18·0*	*12·6*	*10·7*	*7·4*	*4·1*	*1·0*
Below £1 000	156	*0·9*	20	68	17	13	8	3	5	4	5	13
£1 000 — 1 199	137	*0·8*	14	83	17	3	2	1	3	2	5	7
£1 200 — 1 399	423	*2·4*	16	279	75	19	5	6	7	7	8	3
£1 400 — 1 599	792	*4·5*	3	407	256	57	19	11	11	10	11	7
£1 600 — 1 799	1 248	*7·1*	2	400	487	181	74	38	38	24	14	10
£1 800 — 1 999	1 547	*8·8*	—	211	631	348	163	72	81	36	20	5
£2 000 — 2 499	4 627	*26·2*	—	172	1 208	1 345	788	398	366	214	125	23
£2 500 — 2 999	3 305	*18·7*	—	18	271	914	891	503	342	244	101	21
£3 000 — 3 999	3 115	*17·6*	—	5	62	427	824	685	527	364	201	20
£4 000 — 4 999	1 437	*8·1*	1	1	17	106	291	352	303	234	109	23
£5 000 — 5 999	423	*2·4*	—	—	2	13	58	81	111	81	60	17
£6 000 and over	457	*2·6*	—	—	4	17	53	73	120	94	73	23
	£		£	£	£	£	£	£	£	£	£	£
Lowest decile	1 641		*	1 210	1 561	1 841	2 041	2 150	2 119	2 131	2 054	*
Lower quartile	2 012		*	1 386	1 768	2 088	2 363	2 524	2 488	2 553	2 486	1 920
Median	**2 489**		**1 107**	**1 593**	**2 015**	**2 410**	**2 787**	**3 067**	**3 155**	**3 207**	**3 302**	**2 933**
Upper quartile	3 198		*	1 798	2 267	2 766	3 360	3 831	4 126	4 242	4 364	4 600
Highest decile	4 259		*	2 051	2 544	3 299	4 199	4 677	5 248	5 240	5 992	*

* Numbers in these groups are too small to justify calculation of deciles

Analysis by income and geographical area of employment

Table 19

	TOTAL		Geographical area of employment								Area of employment not stated
			London	Birmingham	Southern	Manchester/ Liverpool	Northern	Wales	Scotland	Ireland	
ALL SCIENTISTS	25 560		6 291	2 211	6 071	2 993	4 944	1 042	1 713	276	19
		%	*24·6*	*8·7*	*23·8*	*11·7*	*19·4*	*4·1*	*6·7*	*1·1*	
Below £1 000	1 308	*5·1*	287	126	324	157	280	57	63	14	—
£1 000 — 1 199	1 411	*5·5*	271	139	350	171	329	60	81	9	1
£1 200 — 1 399	1 969	*7·7*	398	194	477	243	453	97	91	16	—
£1 400 — 1 599	2 149	*8·4*	387	233	573	271	466	76	120	20	3
£1 500 — 1 799	2 235	*8·7*	418	214	556	280	492	111	145	18	1
£1 800 — 1 999	2 202	*8·6*	471	182	550	279	447	96	167	18	2
£2 000 — 2 499	5 276	*20·6*	1 192	514	1 256	595	1 031	253	353	76	4
£2 500 — 2 999	3 496	*13·7*	983	258	793	382	598	136	309	39	1
£3 000 — 3 999	3 174	*12·4*	989	214	687	372	517	104	244	43	4
£4 000 — 4 999	1 450	*5·7*	518	79	343	140	204	39	109	16	2
£5 000 — 5 999	427	*1·7*	155	25	96	55	62	9	22	3	—
£6 000 and over	461	*1·8*	222	33	66	46	65	5	19	2	1
	£		£	£	£	£	£	£	£	£	£
Lowest decile	1 177		1 228	1 150	1 155	1 160	1 125	1 173	1 266	1 242	*
Lower quartile	1 558		1 700	1 474	1 511	1 518	1 456	1 520	1 700	1 663	1 528
Median	**2 143**		**2 351**	**2 000**	**2 060**	**2 050**	**2 000**	**2 028**	**2 262**	**2 251**	**2 267**
Upper quartile	2 874		3 182	2 540	2 716	2 750	2 625	2 552	2 900	2 858	3 240
Highest decile	3 931		4 336	3 395	3 750	3 704	3 495	3 298	3 750	3 765	*

* Numbers in these groups are too small to justify calculation of deciles

ALL SCIENTISTS IN SAMPLE

Analysis by field of employment and type of work

Table 20

	TOTAL		General technical admin.	Production	Analysis, testing of materials or instrumentation and control	Research and development	Design	Teaching	Technical service or sales or similar commercial work	Consultancy	Other scientific work	Non-scientific work	Type of work not stated
ALL SCIENTISTS	**25 560**		**2 383**	**1 835**	**2 652**	**9 073**	**216**	**6 342**	**1 152**	**460**	**977**	**409**	**51**
		%	*9·3*	*7·2*	*10·4*	*35·6*	*0·8*	*24·9*	*4·6*	*1·8*	*3·8*	*1·6*	
Manufacturing Total	**11 652**	**45·6**	**1 592**	**1 686**	**1 571**	**4 841**	**172**	**34**	**1 032**	**129**	**325**	**242**	**26**
Food	778	*3·0*	137	104	179	289	1	—	20	9	16	20	3
Oil	493	*1·9*	60	41	77	194	8	—	65	8	26	14	—
Chemical or allied	2 617	*10·2*	341	446	305	976	33	6	342	33	71	59	5
Pharmaceutical	922	*3·6*	60	114	219	462	5	3	26	4	16	13	—
Plastics and polymer	951	*3·7*	112	109	79	487	7	1	113	5	23	14	1
Iron and steel	1 026	*4·0*	168	215	135	349	1	5	107	10	19	11	5
Non-ferrous metals	779	*3·1*	123	185	75	264	—	1	83	6	18	21	3
General engineering	854	*3·3*	189	138	134	251	29	1	45	15	28	20	3
Electrical and electronic equipment	1 267	*5·0*	127	88	118	712	66	8	103	14	40	19	2
Aerospace	336	*1·3*	48	34	32	155	20	2	7	5	24	8	1
Textile	307	*1·2*	41	49	33	139	1	4	17	5	7	10	1
Other manufacturing	1 303	*5·1*	186	185	185	563	11	3	104	14	37	33	2
Mining and quarrying	**131**	**0·5**	**24**	**2**	**39**	**47**	—	—	**8**	**2**	**6**	**3**	—
Hospitals	**234**	**0·9**	**47**	—	**61**	**61**	—	—	**3**	**17**	**43**	**1**	**1**

Table 20 (*continued*)

	TOTAL		General technical admin.	Production	Analysis, testing of materials or instrumentation and control	Research and development	Design	Teaching	Technical service or sales or similar commercial work	Consultancy	Other scientific work	Non-scientific work	Type of work not stated
Public utilities		%											
Total	**1 051**	*4·1*	**173**	**67**	**327**	**310**	**19**	**5**	**26**	**18**	**94**	**10**	**2**
Gas production or distribution	164	*0·6*	17	36	59	31	1	—	10	2	7	1	—
Electricity generating or distribution	512	*2·0*	69	23	152	194	14	1	7	6	41	4	1
Water supply, river purification	194	*0·8*	61	—	84	14	1	—	7	1	24	1	1
Transport (by rail, road, air, water)	116	*0·5*	15	6	18	53	2	—	—	8	11	3	—
Postal services, telecommunications or broadcasting	65	*0·3*	11	2	14	18	1	4	2	1	11	1	—
Research													
Research institution, association or station	**2 908**	**11·4**	**110**	**14**	**167**	**2 443**	**7**	**8**	**13**	**28**	**110**	**6**	**4**
Education													
Total	**7 455**	**29·2**	**75**	**3**	**34**	**920**	**3**	**6 213**	**6**	**16**	**147**	**34**	**4**
University	**3 291**	*12·9*	44	2	33	867	1	2 174	3	11	129	25	2
Technical college	**2 240**	*8·8*	28	—	1	50	1	2 138	3	4	11	2	2
College of education	302	*1·2*	1	—	—	3	—	292	—	1	3	2	—
School	1 622	*6·4*	2	1	—	—	1	1 609	—	—	4	5	—
Public administration													
Total	**1 091**	*4·3*	**254**	**29**	**365**	**250**	**2**	**18**	**16**	**33**	**99**	**22**	**6**
Central Government administration	373	*1·5*	189	13	7	53	—	14	7	17	47	22	4
Government or municipal laboratory	718	*2·8*	65	16	358	197	2	2	8	16	52	—	2
Consulting firms	**281**	**1·1**	**8**	**2**	**45**	**24**	**2**	**1**	**11**	**180**	**8**	**2**	—
Other fields	**729**	**2·9**	**96**	**28**	**42**	**166**	**11**	**60**	**47**	**37**	**147**	**66**	**7**
Field not stated	**28**		**4**	**2**	**1**	**9**	—	**5**	**1**	**2**	—	**3**	**1**

ALL SCIENTISTS IN SAMPLE

Analysis by field of employment and class of employer

Table 21

	TOTAL		Self-employed	Central government	Hospital board	Local authority	Nationalized industry or public corporation	UKAEA	University	Industrial or commercial company or private firm	Any other employer	Employer not stated
ALL SCIENTISTS	**25 560**		**249**	**2 371**	**245**	**4 036**	**1 682**	**858**	**3 155**	**12 223**	**735**	**6**
		%	*1·0*	*9·3*	*1·0*	*15·8*	*6·6*	*3·4*	*12·3*	*47·8*	*2·9*	
Manufacturing industry	11 652	*45·6*	64	56	—	6	665	99	7	10 730	25	1
Mining or quarrying	131	*0·5*	2	—	—	—	101	—	1	26	1	—
Gas, electricity, water	870	*3·4*	—	4	—	138	570	45	—	95	17	1
Transport and communications	181	*0·7*	1	14	—	1	113	1	—	49	2	—
Hospitals	234	*0·9*	—	3	221	—	—	—	4	1	5	—
Research institution, association or station	2 908	*11·4*	3	1 189	15	2	200	541	66	820	71	1
Education	7 455	*29·2*	6	225	5	3 641	6	1	3 061	22	486	2
Central Government administration	373	*1·5*	—	350	—	4	6	12	—	—	1	—
Government or municipal laboratory	718	*2·8*	2	437	1	165	3	104	1	3	2	—
Consulting firms	281	*1·1*	112	—	—	—	1	—	—	166	2	—
Other work	729	*2·9*	58	90	3	70	17	51	15	302	123	—
Field not stated	**28**		**1**	**4**	—	**9**	—	**4**	—	**9**	—	**1**

ALL SCIENTISTS IN SAMPLE

Analysis by type of work performed and class of employer

Table 22

	TOTAL		Self-employed	Central government	Hospital board	Local authority	Nationalized industry or public corporation	UKAEA	University	Industrial or commercial company or private firm	Any other employer	Employer not stated
ALL SCIENTISTS	**25 560**		**249**	**2 371**	**245**	**4 036**	**1 682**	**858**	**3 155**	**12 223**	**735**	**6**
		%	*1·0*	*9·3*	*1·0*	*15·8*	*6·6*	*3·4*	*12·3*	*47·8*	*2·9*	
General technical administration	2 383	*9·3*	24	297	48	96	201	61	45	1 559	31	1
Production	1 835	*7·2*	11	44	1	4	192	57	2	1 519	5	—
Analysis, testing of materials, or instrumentation and control	2 652	*10·4*	22	243	59	203	360	96	36	1 616	16	1
Research and development	9 073	*35·6*	17	1 404	66	70	726	534	747*	5 406	101	2
Design	216	*0·8*	3	6	—	2	10	8	1	186	—	—
Teaching	6 342	*24·9*	6	108	2	3 562	9	3	2 166	26	469	1
Technical service or sales, or similar commercial work	1 162	*4·6*	13	13	3	6	64	15	*3*	1 039	6	—
Consultancy, if not covered in one of the other categories	460	*1·8*	113	41	20	11	18	9	9	227	12	—
Other scientific occupation	977	*3·8*	21	179	44	60	79	47	119	358	70	—
Non-scientific occupation	409	*1·6*	19	28	1	28	16	5	25	264	22	1
Type of work not stated	**51**		**—**	**8**	**1**	**4**	**7**	**3**	**2**	**23**	**3**	**—**

* It is important to note that the 747 scientists shown here as engaged in research and development in universities do not represent the full strength of research workers in these establishments. A considerable amount of research will, of course, be carried out by the 2166 university teachers. (See also Question V, section B(D)).

MEMBERSHIP OF THE SCIENCE INSTITUTES within the Council of Science and Technology Institutes
1 April 1968

Table 23	Total home and overseas members	Home members			
		Total	Fellows, Associates	Graduates	Licentiates
The Institute of Biology	4 932	4 475	3 477	998	
The Royal Institute of Chemistry	22 997	20 143	14 926	1 851	3 366
The Institute of Mathematics and its Applications	2 380	2 260	1 330	805	125
The Institution of Metallurgists	7 738	6 602	4 534	676	1 392
The Institute of Physics and The Physical Society	10 340	8 777	4 794	3 571	412

TECHNICAL NOTE

The survey was conducted by the five science institutes, each of which sent a questionnaire to all its home members. Reminders were not sent, but the survey was given prominance in the journals. Just under 40 000 questionnaires were despatched and the number of completed ones returned produced an overall response rate of 89·3 per cent.

The questionnaire used in this survey, reproduced on pages 40 and 41, was more complicated than that used in previous surveys. The response rate is shown in the table below. In addition a comparison is made between the number of completed questionnaires returned to the science institutes and the estimated population within Great Britain qualified in the relevant scientific disciplins. The Institute of Mathematics and its Applications was established only recently, in 1964, and this accounts for the relatively small number of mathematicians in its membership when the survey was made in 1968.

Each institute edited the questionnaires from its own members and removed those cards which were not acceptable.

These included cards for:
(*a*) all respondents who did not state either age or income or both,
(*b*) all unemployed or retired respondents,
(*c*) all respondents not in full-time employment,
(*d*) all post-graduate students,
(*e*) all self-employed respondents of The Institute of Mathematics and its Applications.

The initial processing of the edited questionnaires was undertaken by the Computer Department of the Glaxo Group of companies, and the results for each institute were produced seperately. The analysis of results and the commentary for the separate surveys were published by the five bodies, mainly in their respective journals. (Details are given on page 38.) The complete magnetic tape was then passed to the Ministry of Technology, and further analysis produced the data for the tables in this volume.

Scientists replying in survey

Table 24	Scientists replying to survey	Scientists replying as a proportion of: those receiving questionnaires	those in economically active population(1)
		%	%
Total	**27 683**	**69**	**25**
The Institute of Biology	2 855	*64*	*14*
The Royal Institute of Chemistry	14 336	*74*	*33*
The Institute of Mathematics and its Applications	1 398	*70*	*7*
The Institution of Metallurgists	3 672	*62*	*52*
The Institute of Physics and The Physical Society	5 422	*67*	*27*

(1) Persons in Great Britain with a degree or equivalent qualification in the relevant discipline

Institute of Biology;
Journal, Vol. 15, No. 3

Royal Institute of Chemistry;
Supplement to *Chemistry in Britain*, Vol. 4, No. 8, September 1968

Institute of Mathematics and its Applications;
Not published. Booklet sent to members

Institution of Metallurgists;
Metals and Materials, Vol. 3, No. 7, July 1969, p269

Institute of Physics and The Physical Society;
Physics Bulletin, Vol. 19, August 1968, p266 and November 1968, p385

Questionnaire

The form of questionnaire used by the five institutes is reproduced on the next two pages. There was one divergence from the common layout; The Institute of Biology asked an additional question to obtain information about the frequency of occurrence of medical degrees.

Each institute distinguished the grade of membership and sex of the respondent in its own questionnaire.

REMUNERATION SURVEY, 1968

Would you please complete this questionnaire card and return it in the accompanying envelope (postage prepaid) as soon as possible. The information that you provide will be included in the Survey if received by 28 May. If you have retired or you are not in employment only the first three questions need be answered, but it is important that the card should be returned.

The cards will be processed by computer, so please write clearly and boldly. No signature is required and anonymity will be strictly preserved. Should you have any difficulty in answering a particular question please select the code letter or number that is most appropriate, even if it is not quite correct. Only one letter or number should be used for each answer.

I. SOCIETY, GRADE OP MEMBERSHIP ...../Fellow/Male

(Please check and amend if incorrect. The printed coding will then be altered.)

II. AGE, in years only, at 1 April, 1968

Please answer questions III-V and VII by inserting the most appropriate codes from the schedules given overleaf.

III. CLASS OF EMPLOYER

NOTE: If in Group J or K it is not necessary to answer any further questions, but please return the card.

IV. FIELD OF EMPLOYMENT

V. TYPE OP WORK

Section A

Section B

VI. QUALIPICATIONS

A. If you hold one of the degrees named below, please state name of university or awarding body, and subject

	Awarded by	*Subject*
Ph.D. or D.Phil.		
M.Sc.		
B.A. or B.Sc.		

B. Please list *all* your qualifications (excluding honorary degrees)

(No entry should be made in the square your answers will be coded for you)

VII. GEOGRAPHICAL AREA OP EMPLOYMENT (see schedule overleaf)

VIII. TOTAL EARNED INCOME during the year ended 5 April 1968 from salaried employment, and/or professional services, in accordance with the notes below:—

INCOME PROM MAIN OCCUPATION *

INCOME PROM SECONDARY OCCUPATION(S), IF ANY *

* To nearest pound only, please.

For a member in salaried employment—

Income from main occupation should be taken to mean the total sum (before deduction of tax) received from the sole or principal employer in the form of salary—plus bonus, share of profits, commission, fees or honoraria, or any other monetary payment other than a refund of expenses incurred—during the fiscal year that ended on 5 April, 1968. The correct sum will normally be the one shown on tax form P.60, which should have been received by employees before the end of April.

Income from secondary occupation(s) should be taken to mean the total sum (if any), as defined above, that has been received from any other employer or client for work that is consistent with, but not part of the main occupation. Examples are evening class teaching fees, examiner's fees, royalties, part-time consultancy fees.

For a member who is self-employed (and not otherwise in receipt of a fixed income) main and secondary income are irrelevant. Gross earnings from all sources should be stated as income from main occupation.

Note: Income Tax, National Insurance contributions, or contributions made under a group superannuation scheme should not be deducted; any insurance or superannuation contributions paid by an employer should not be added. No additions should be made for benefits in kind (e.g. use of car, sickness or accident insurance cover, accommodation at a nominal rent).

CODING SCHEDULES FOR QUESTIONS III to V and VII.

Q. III. CLASS OF EMPLOYER (IF SELF-EMPLOYED SEE CLASS I)

A CENTRAL GOVERNMENT (including Research Councils) AND ARMED FORCES (excluding G.P.O., cf.D)
B HOSPITAL BOARD (within National Health Service)
C UNITED KINGDOM ATOMIC ENERGY AUTHORITY
D NATIONALIZED INDUSTRY OR PUBLIC CORPORATION (please include G.P.O.: also B.B.C., N.P.A., etc.)
E LOCAL AUTHORITY (including technical college, training college or school under Local Authority; also any establishment controlled by a group of Local Authorities)
F UNIVERSITY (including Agricultural or Medical School)
G INDUSTRIAL OR COMMERCIAL COMPANY, PARTNERSHIP OR FIRM: CONSULTING PRACTICE: INDUSTRIAL RESEARCH ASSOCIATION (if not wholly financed by Government); TRADE ASSOCIATION

H ANY EMPLOYER NOT COVERED BY A-G. Please specify.....

.....

I SELF-EMPLOYED in any capacity, including as a Principal or Partner of a private consulting practice.

J UNEMPLOYED, and under normal retiring age for last appointment.
K RETIRED, and not fully re-employed. If fully re-employed use appropriate code letter above.

Q. IV. FIELD OF EMPLOYMENT

10 Central Government Administration.
11 Government or Municipal Laboratory (analytical, testing or service).
12 Research Institute, Association or Station. (Government or otherwise.)
13 Hospital (non-teaching post).
14 Postal services, telecommunications or broadcasting.
15 Mining or quarrying (including coal mining or distributing).
16 Gas production and distribution.
17 Electricity generation and distribution.
18 Transport (by road, rail, air, water).
19 Water supply; River purification.
20 Iron & Steel Industry.
21 Non-ferrous metals Industry.
22 Electrical and Electronic Equipment Industry.
23 General Engineering Industry.
24 Aerospace Industry.
25 Oil Industry.
26 Plastics and Polymer Industry.
27 Pharmaceutical Industry.
28 Chemical or Allied Industry.
29 Food Industry.
30 Textile Industry.
31 Any other Manufacturing Industry.
32 University (including Agricultural or Medical School of a University).
33 Technical College
34 College of Education.
35 School.
36 Consulting firm.
37 Any field of employment not covered by 10-36. Please specify .....

Q. V. TYPE OF WORK (It is realised that the classifications are not precise. Please choose the code letter in each of the two sections that seems most appropriate, even if not entirely suitable).

Section A

A Administrative or managerial, as a scientist or technologist.
B Administrative or managerial, NOT as a scientist or technologist.
C NOT administrative or managerial.

Section B

A General technical administration.
B Production.
C Analysis, testing of materials, or instrumentation and control.
D Research and development (not as part of teaching appointment).
E Design.
F Teaching.
G Technical Service or Sales, or similar commercial work.
H Consultancy (if not covered by *one* of the categories above).
I Other scientific or technological work.
J Non-scientific work.

Q. VII. GEOGRAPHICAL AREA OF EMPLOYMENT. (Please choose area that you consider most appropriate, even if not strictly accurate).

A ENGLAND—LONDON AREA: Within 20 miles of Westminster.
B ENGLAND—BIRMINGHAM AREA: Within 30 miles of centre of Birmingham.
C ENGLAND—SOUTHERN: South of line drawn due East-West through centre of Birmingham, but not in A or B.
D ENGLAND—MANCHESTER/LIVERPOOL AREA: Within 20 miles of centre of either city.
E ENGLAND—NORTHERN: North of line drawn East-West through centre of Birmingham but not B or D.
F WALES.
G SCOTLAND.
H NORTHERN IRELAND or REPUBLIC OF IRELAND.

The Survey of Professional Scientists 1968

Ministry of Technology
and the Council of Science and
Technology Institutes

Studies in Technological Menpower
No. 2

London 1970
Her Majesty's Stationery Office

Steering Committee for the Survey of Professional Scientists 1968

Membership

Ministry of Technology
Mrs J G Cox (Chairman)

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Institute of Physics and The Physical Society

Ministry of Technology
Mr J R Bowles (Secretary)

Preface

This survey of professional scientists and applied scientists has been undertaken jointly by the Ministry of Technology and the five science institutes listed on page 1. It is the most comprehensive study of scientists and their remuneration which has been undertaken in the United Kingdom. The survey was designed to provide, for the first time, a profile of professional scientists closely comparible with that of the professional engineers.

Contents

Introduction

The engineering profession

National prosperity, in social as well as financial terms, depends upon the efficient use of resources, and technological manpower is as much a resource as money, materials and machinery. Manpower is, however, much less readily measured and much less susceptible to forward planning. In 1966, the Council of Engineering Institutions and the Ministry of Technology decided that more facts were needed about the engineer, his background and his daily work. To remedy this deficiency a survey was undertaken which was aimed at a cross-section of professional engineers. The result of this, *The Survey of Professional Engineers 1966* (Ministry of Technology, HMSO, London 1967) provided the basic information on salary structure, qualifications and deployment within the engineering profession.

The 1966 Survey

A questionnaire was addressed to a sample of 26,000 engineers, approximately 15 per cent of the corporate members (Chartered Engineers) and the graduate members of the constituent institutions of the CEI. Questions covered age, qualifications, employment, income and level of responsibility and evoked a very satisfactory level of response. The main results were published in the following year and further data were contained in *Statistics of Science and Technology 1968*.

interest was considerable and widespread, for this was the first profile of a profession to be produced on this scale, in the United Kingdom or indeed anywhere outside the USA. The Federation of European National Associations of Engineers (FEANI) recommended that other member states should carry out similar studies. Several countries have now either carried out, or have planned their own surveys.

The 1968 Survey

It was natural that the success of the 1966 Survey should stimulate a demand for a periodic survey of the profession and CEI and Mintech determined that the venture be repeated in 1968, so that it coincided with a compatible survey of scientists mounted by the five major science institutes (now linked in the Council of Science and Technology Institutes) and with the 1968 survey of persons with qualifications in engineering, technology and science and its questionnaire to employers. A two-year interval was not expected to demonstrate many significant trends, nor to offer evidence of the results of national or institution policies. There were, however, some problems raised as a result of the analysis of the 1966 Survey and an opportunity was taken to include some additional questions. As will be seen from the specimen questionnaire, reproduced on pages 49 to 57, the more important of these covered unemployment, in-career training and the area of technology in which the respondent practised.

Comparisons between 1966 and 1968

The presentation of the primary information follows much the same pattern as in the earlier report with some additional diagrams and, where appropriate, columns of comparable data from both surveys. The first part of the report contains the more general information but greater detail is to be found in the tables of the second part.

As might be expected, there has been a small increase in the proportion of younger engineers and a small but significant increase in the proportion of university graduates. The proportion employed in industry and commerce has fallen very slightly, the field of manufacturing industry showing the greatest loss. Over twice as many engineers report that they are engaged in work of a non-engineering nature, although the percentage in the sample so employed is still small.

The 1966 Survey pioneered the question of the levels of engineering responsibility in this country. The survey showed that 69.6 per cent of members considered that they held managerial posts. The data collected in 1968 reveal that this already high proportion has advanced to 62.6 per cent. Furthermore, those in the sample occupying posts in 'top management' had advanced from 11.4 per cent to 12.3 per cent.

Median incomes have risen by 12 per cent in the two years across almost the whole age range, though the rate falls for the over 60's. There has been some narrowing of differentials between the non-graduate sector, approximately two-thirds of the whole and biased towards the older age groups, and the graduate sector. However, the salary level of university graduates remains higher throughout the whole age range.

The questions relating to unemployment show that while 0.4 per cent of the professional engineers who responded were unemployed at the time of the survey, a further 1.1 per cent had been unemployed at some time during the previous twelve months. These were spread fairly evenly through the age groups.

Post-experience training

There is some concern regarding the obsolescence of traditional engineering skills and the likelihood that the older engineer may be suffering in consequence. The need to encourage post-experience training is self-evident: the medical profession could be cited as giving a lead in this direction. Despite the emphasis on this aspect of training, doubts had been expressed that too few engineers took advantage of the courses offered by the universities and other advanced educational establishments or alternatively that many of these courses were unacceptable in duration or content.

The 1968 survey has indicated a rather better position than had been feared. The data show that over one-third of the members who replied to the survey had undertaken some course of training in the previous twelve months. These courses, which included technical, language and business studies, were taken not only by the younger engineers, but also by engineers in mid or late career. It should, however, be remembered that, of the courses taken, both full- and part-time, some 40 per cent were of only one week's duration or less. The total time spent by the profession on course training is still far from adequate.

Profiles of professional engineers and scientists

It has been agreed with the Council of Science and Technology Institutes that reciprocal publication of data on the remuneration of engineers and scientists would be of considerable interest.

The charts and table on pages 26 and 27 showing median incomes by age groups have been prepared jointly by the two bodies to illustrate the similarities and differences between the profiles of professional engineers and scientists.

Part one Charts and summary tables

Age distribution of engineers

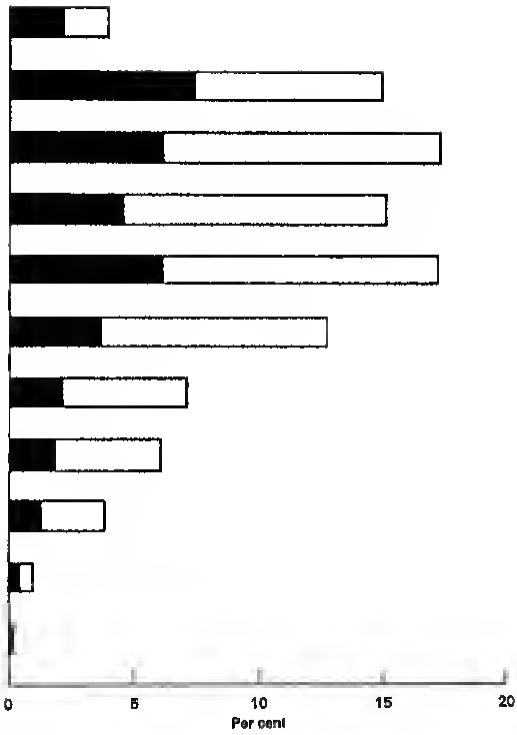


Table 1	Sample number	Per cent 1965	Per cent 1966
All engineers	19 497		
Engineers stating age	19 444	*100·0*	*100·0*
Under 25	732	*4·0*	*2·9*
25 — 29	2 762	*15·0*	*15·1*
30 — 34	3 202	*17·4*	*16·5*
35 — 39	2 759	*15·1*	*17·1*
40 — 44	3 197	*17·3*	*17·8*
45 — 49	2 375	*12·9*	*10·1*
50 — 54	1 306	*7·1*	*8·0*
55 — 59	1 134	*6·1*	*6·4*
60 — 64	715	*3·9*	*4·7*
65 — 69	189	*1·0*	*1·1*
70 & over	43	*0·2*	*0·2*

■ University graduates

Engineers fell into three approximately equal groups: about a third were aged under 35, a third were between 35 and 44, and the remaining third were 45 or over. This is almost exactly the distribution found in the 1965 survey.

A feature of the age distribution in the 1966 survey was the 'bulge' which extended to the age group 40 to 44: thereafter, numbers fell away rapidly. In 1956, this 'bulge' had extended into the 45 to 49 age group

The proportion of those under 25 increased in 1966, but figures for this age group underestimate the new entry, since some university graduates do not join an institution for some time after taking a degree. The 1966 Census, for instance, suggests that the percentage age of qualified engineers under 25 was about 6·6.

●See also Tables 6, 10, 15-19 and 20-26; Question 2.

There have been changes since 1965 in the three age groups from 30 to 44, with an increase in the percentage age 30 to 34, a drop at ages 35 to 39, and a small decrease at ages 40 to 44. A number of factors have combined to produce these changes, including the post-war university expansion, increased enrolment of members of institutions before the qualifications for membership were changed, and emigration among younger engineers.

The proportion of engineers who are university graduates increased from 1965 to 1966, from 33·8 per cent to 35·2 per cent. There are more graduates among the younger than among the older engineers: 43·5 per cent of engineers under 35 were graduates, compared with 31·9 per cent of those aged 35 and over.

●Due to rounding off, the percentages in the tables in this survey do not total 100%

Employers

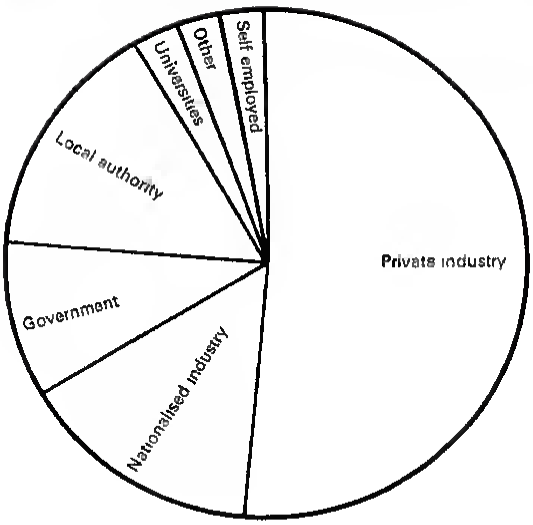


Table 2	Semple number	Per cent 1968	Per cent 1966
All engineers	18 497		
Engineers stating employer	19 407	*100·0*	*100·0*
Self-employed	541	*2·9*	*2·7*
Employed by—			
Industrial or commercial firms	8 523	*46·3*	*53·4*
Consultant	1 029	*5·6*	
Nationalized industry	2 602	*15·2*	*15·1*
Central Government	1 112	*6·0*	*6·1*
The Armed Forces	379	*2·1*	*2·2*
The UK Atomic Energy Authority	310	*1·7*	*1·7*
Local authority	2 779	*15·1*	*14·2*
University	474	*2·6*	*2·4*
Other employers	458	*2·5*	*2·2*

More than half the engineers were employed by industrial or commercial firms or by consultants. The percentage in 1966 is, however, slightly lower than in 1966 (and there is a parallel reduction in the percentage whose field of work is manufacturing industry (page 6). The next largest employers were the nationalized industries and local government, both with 15 per cent of engineers.

About 70 per cent of all professional engineers are employed by public or private industry and commerce.

Table 15 shows wide variations in the age distributions of engineers for different employers. Firms of consultents end industrial and commercial companies had a marked preponderance of young engineers, 54 per cent of those employed by consultants and 42 per cent of those employed in industry and commerce being under 35. Universities are somewhat below this, with 39 per cent of their engineers under 35. In contrast, Central Government has a proportion of engineers under 35 of only 16 per cent. This is particularly significant since in this area corporate membership of a professional institution is normally a condition for permanent employment.

● See also Tables 15 and 21; Question 7.

Type of work

The distribution of engineers by type of work is shown in the chart below, with shaded areas representing those in administrative or managerial positions. In total, 62 per cent of engineers were in these positions, compared with 55 per cent in 1966, and this increase was general over all types of work. Table 7 shows a parallel increase in engineers' responsibilities, and shows also that it had occurred notably among the younger engineers.

More than a quarter of engineers were in general technical administration, and nearly a third were in research and development and design. There is little change between 1966 and 1966 in the proportions in the various types of work although the last item, 'not engineering work', had more than doubled since 1866. A large proportion of these also answered, in Question 8, that they were in administrative or managerial positions, which suggests that most of the increase is likely to be due to transfers to non-engineering management rather than to engineers embarking on new careers outside the profession.

Table 17 shows the age distribution. Instrumentation and control, design, and research and development all had a marked preponderance of younger engineers, and construction and installation showed the same trend but to a lesser extent. The opposite trend, with a preponderance of older engineers, was shown in consultancy, commercial work, and general technical administration (where it was particularly strongly marked). Those not in engineering occupations showed the same general pattern, but with a very high proportion of engineers in the age group 50 to 59.

Tables 18 and 19 give the age distribution of those in and of those not in administrative or managerial positions. The proportions of those in such positions increase steadily with age from 31 per cent of those aged under 30 to 79 per cent of those aged 60 to 59. Thereafter, however, the proportion drops: 74 per cent of those aged 60 and over were in managerial positions.

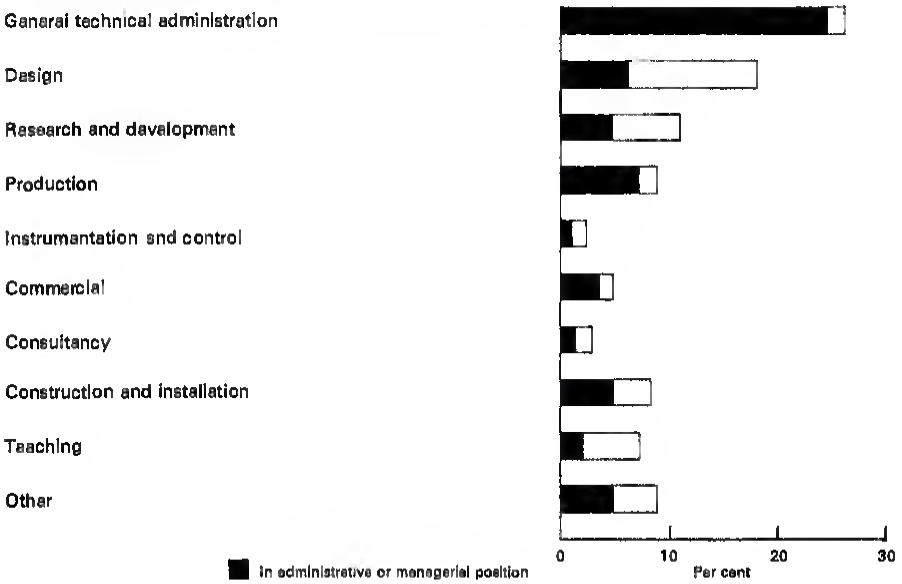


Table 3	Sample number	Per cent 1966	Per cent 1996	In managerial positions	In other positions
All engineers	18 497	%	%	11 394	7 103
Engineers stating type of work	19 351	*100·0*	*100·0*	11 322	7 029
General technical administration	4 650	*26·4*	*26·7*	4 564	286
Design	3 376	*18·4*	*18·1*	1 147	2 231
Research and development	2 089	*11·4*	*12·5*	861	1 228
Production	1 677	*9·1*	*9·4*	1 341	336
Instrumentation and control	443	*2·4*	*2·3*	202	241
Commercial	926	*5·0*	*5·6*	694	232
Consultancy	544	*3·0*	*3·1*	295	249
Construction and installation	1 513	*8·2*	*8·4*	942	671
Teaching	1 379	*7·5*	*7·1*	361	998
Other engineering work	601	*4·4*	*5·1*	369	432
Not engineering work	751	*4·1*	*1·7*	526	225

●See also Tables 16, 19 and 20; Questions 9 and 10.

Field of work

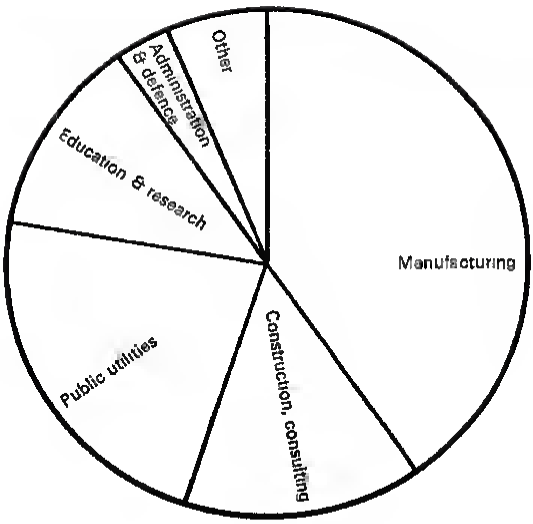


Table 4	Sample number	Per cent 1968	1966
All engineers	18 497		
Engineers stating field	18 426	*100·0*	*100·0*
Manufacturing	7 466	*40·5*	*43·3*
Mining and quarrying	387	*2·1*	*2·9*
Gas, electricity and water	1 792	*9·7*	*10·4*
Transport and communications	924	*5·0*	*4·9*
Municipal engineering	1 420	*7·7*	*7·4*
Construction	1 429	*7·8*	*6·2*
Consulting firms	1 286	*7·0*	*6·2*
Research institutions	726	*3·9*	*4·2*
Central Government administration	321	*1·7*	*2·0*
The Armed Forces	322	*1·7*	*1·9*
Education	1 570	*8·5*	*8·0*
Other fields	781	*4·2*	*2·7*

The chart and table on this page show the distribution of engineers under main headings: the chart opposite gives the full distribution.

Manufacturing industry had by far the largest percentage of engineers—40·6 per cent. The next largest had fewer than a quarter of industry's figure—gas, electricity and water with 9·7 per cent.

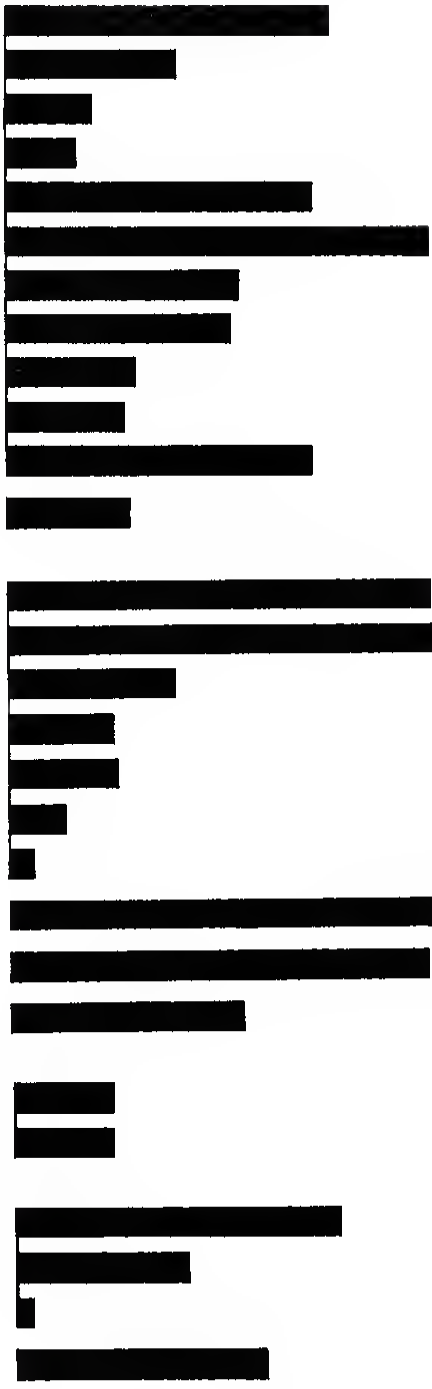
There was a drop, however, in the percentage of engineers in manufacturing industry between 1966 and 1968. The detailed figures opposite show that this drop is notable in electrical machinery and equipment and in aircraft and aero-engines.

Table 20 shows the field of work for engineers in each type of work and makes it possible to examine the fields of work in which the various types are found. Thus manufacturing industry has 58 per cent of all engineers engaged in research and development (just over a third of these are in electronic apparatus manufacture). A further 4 per cent of those engaged in research and development are in universities and technical colleges.

Manufacturing has 42 per cent of design engineers. Public utilities have 25 per cent of them (with municipal engineering taking a large proportion of them—16 per cent). Consulting firms have 16 per cent.

In the educational field, nearly 70 per cent of teachers were in technical or training colleges and nearly 30 per cent in universities. Only 2 per cent were teaching in schools.

PERCENTAGE of all engineers who stated field of work



	1968	1966
Manufacturing		
Chemical or allied	5·5	6·0
Industrial plant and steelworks	2·9	3·2
Metal manufacture	1·5	1·8
Machine tools	1·2	1·2
Other mechanical engineering	5·2	4·6
Electronic apparatus	7·1	6·9
Electrical machinery and equipment	3·9	6·1
Aircraft	3·7	4·2
Shipbuilding and marine engineering	2·3	2·5
Vehicles	2·0	2·1
Other manufacturing	5·2	5·6
Mining and quarrying	2·1	2·9
Public utilities		
Electricity	7·1	7·4
Municipal engineering	7·7	7·4
Transport	2·8	2·7
Gas	1·7	1·8
Postal services, telecommunications	1·8	1·7
Water supply	1·0	1·2
Docks, harbours, inland waters	0·4	0·6
Construction	7·8	6·2
Consulting firms	7·0	6·2
Research institutions	3·9	4·2
Administration, defence		
Central Government administration	1·7	2·0
The Armed Forces	1·7	1·9
Education		
Technical or training college	5·4	5·1
University	2·9	2·5
School	0·3	0·4
Other fields	4·2	2·7

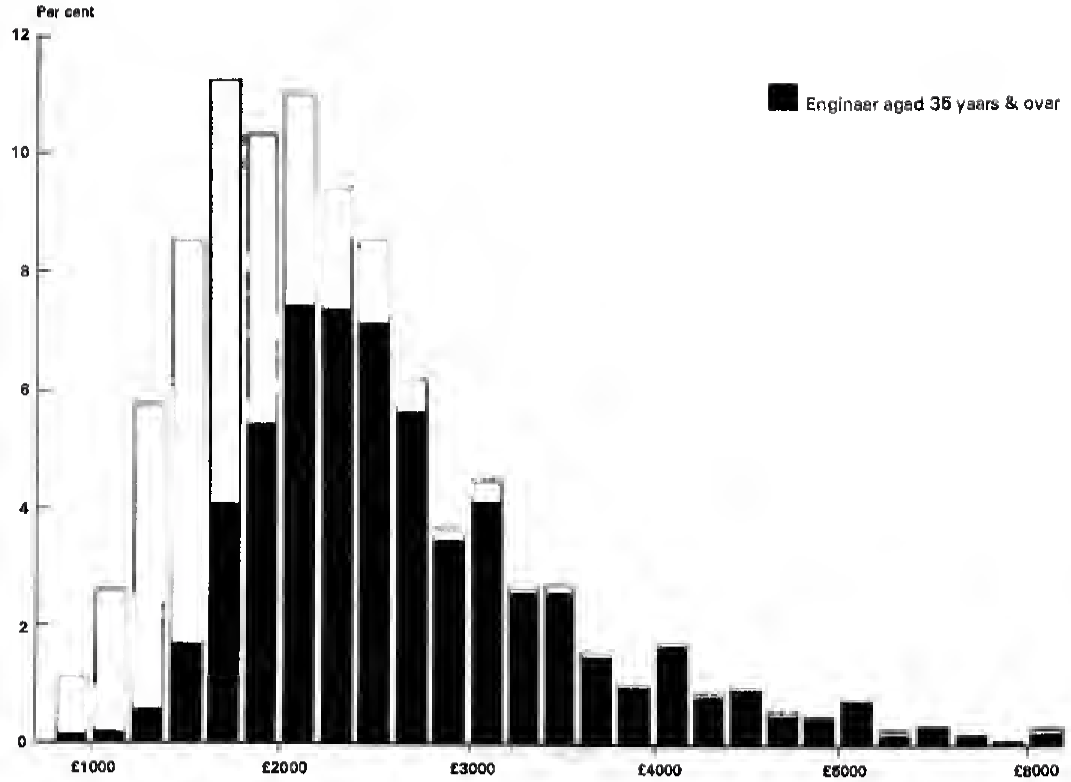
● See also Tables 18, 20 and 21 ; Question 8.

Distribution of incomes

The chart shows the distribution of incomes in the financial year 1967/68 in £200 steps. The full columns show the income distribution for all enginaers and the shaded portions show the distribution for those aged 35 and over. The unshaded portions therefore show to how great an extent the lower range of salaries is affected by the large proportion of younger anginaers.

Earnings for all anginaers at various levels were as follows:

90% earned at least £1410
75% earned at least £1720
50% earned at least £2185
25% earned at least £2790
10% earned at least £3750

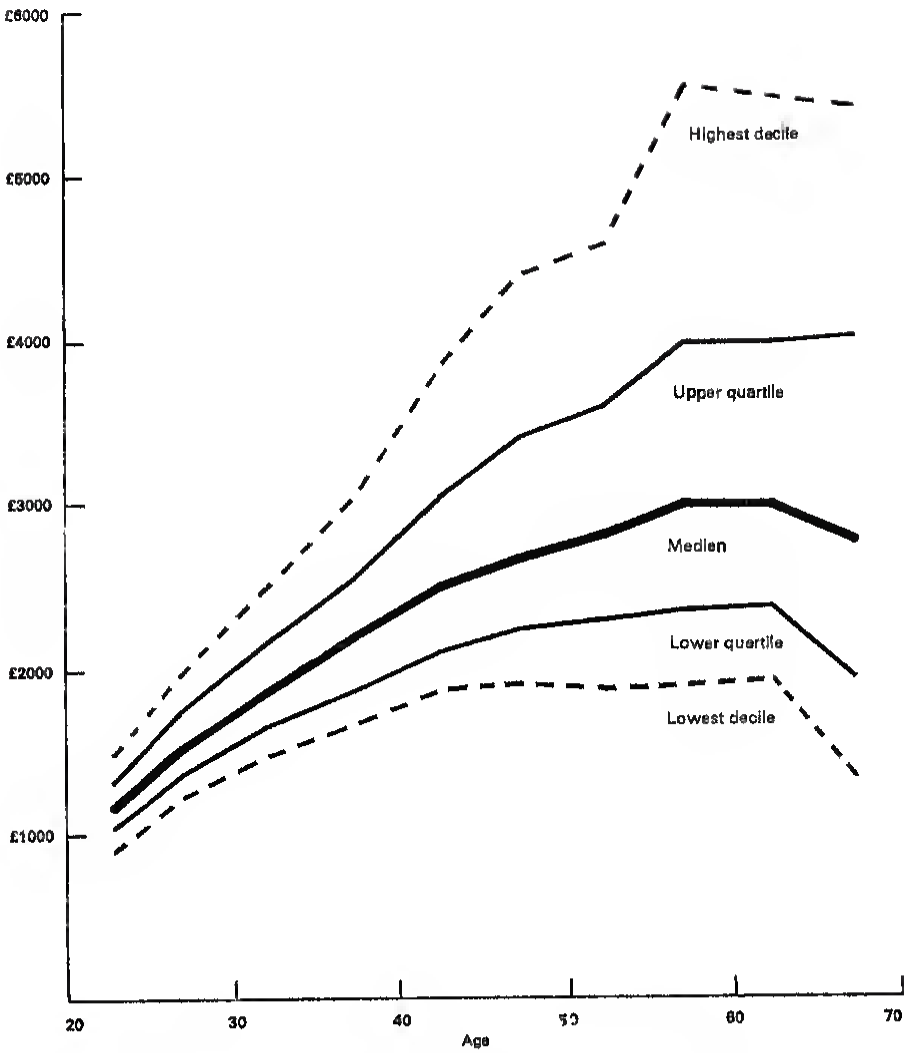


●See also Table 22 and Questions 2 and 12

Distribution of incomes by age

The chart below shows the changes in median, quartile and decile incomes across the age distribution of engineers. Incomes are shown to increase with age—up to a point. In the middle and higher income ranges, this point occurs in the late 50's; but at lower income levels it occurs earlier, with the lines in the chart flattening around the late 40's.

In 1966, no such picture was shown in the middle and higher income ranges, and though some flattening appeared in the lower ranges it was far less marked. It could be inferred that pattern in the distribution of incomes which was beginning to show in 1986 had developed further by 1958.



Incomes comparison 1968 and 1966

The five charts opposite, which compare median, quartile and decile incomes in 1968 with those in 1968, give some indications of what has happened. The increase in incomes at the lower and middle sections of the age distribution have not been matched by corresponding increases at the higher ages, and this is particularly noticeable among the higher incomes, where the 1968 lines fall below those for 1966.

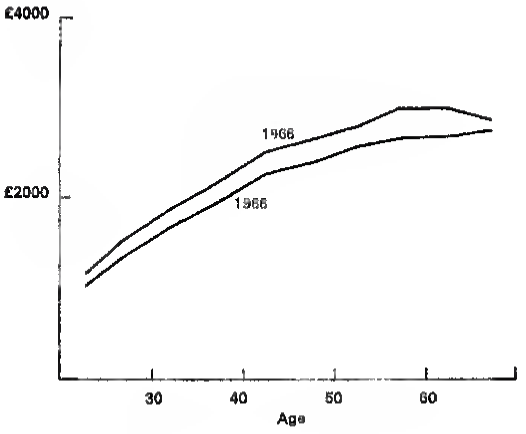
The median income in 1968 for all engineers is 12·1 per cent higher than in 1968. The increases in the three age groups under 36, however, were 13·7, 11·5 and 13·4 per cent, while the increases in each age group from 35 onwards were below 12 per cent. The median income for engineers aged 65 and over increased by only 1·5 per cent between 1965 and 1966.

Table 5	Lowest decile		Lower quartile		Median		Upper quartile		Highest decile	
	1656	1966	1966	1666	1666	1966	1666	1668	1968	1666
	£	£	£	£	£	£	£	£	£	£
All ages	1411	1256	1722	1532	2185	1649	2766	2530	3749	3497
Under 25	696	842	1020	905	1151	1012	1300	1145	1485	1295
25 — 28	1200	1054	1340	1195	1600	1345	1715	1534	1964	1734
30 — 34	1470	1281	1650	1443	1869	1648	2167	1904	2500	2198
35 — 39	1552	1474	1885	1880	2185	1966	2650	2321	3028	2769
40 — 44	1850	1638	2100	1881	2500	2237	3037	2757	3848	3530
45 — 49	1877	1706	2220	2003	2656	2372	3407	3032	4400	4173
50 — 54	1874	1722	2271	2060	2800	2573	3600	3507	4677	4800
55 — 59	1875	1881	2334	2093	3000	2659	4000	3679	5548	5023
60 — 64	1938	1596	2354	2077	3000	2696	4000	4009	5500	6537
85 — 69	*	*	1978	1916	2776	2760	4038	4386	*	*

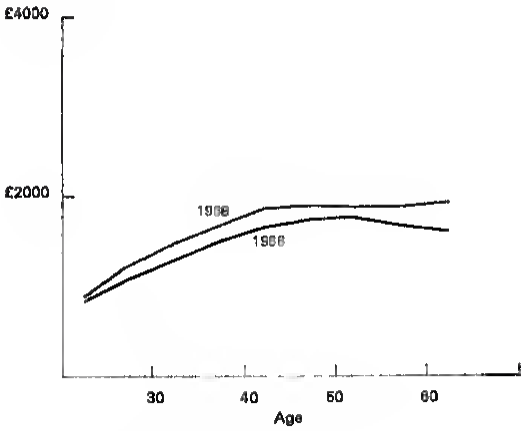
*Numbers in these groups are too small to justify calculation of deciles.

● See also Tables 22, 23 and 24; Question 12.

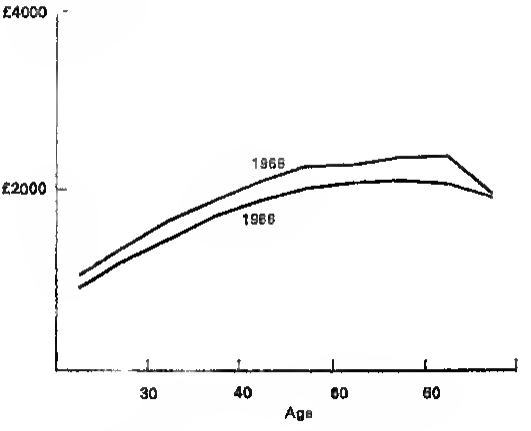
Median



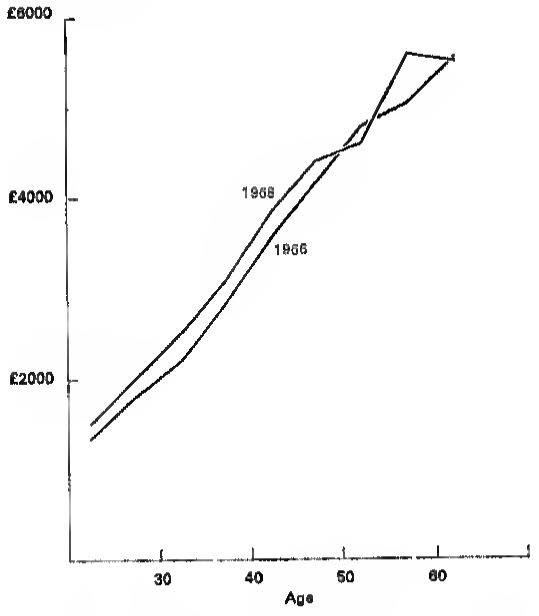
Lowest decile



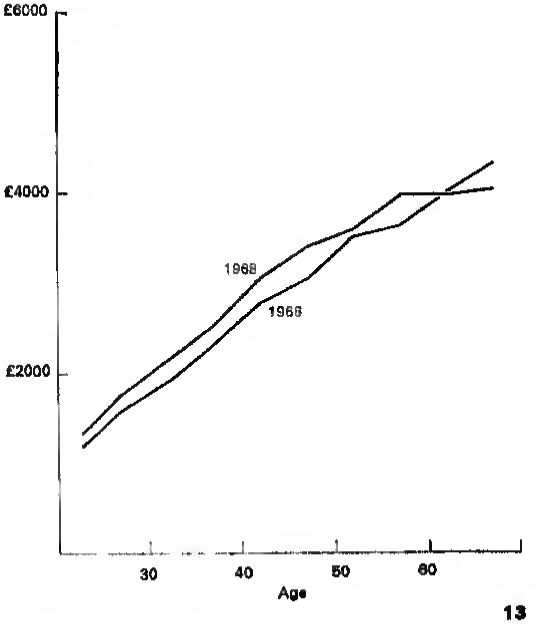
Lower quartile



Highest decile



Upper quartile



Distribution of incomes of graduates and non-graduates

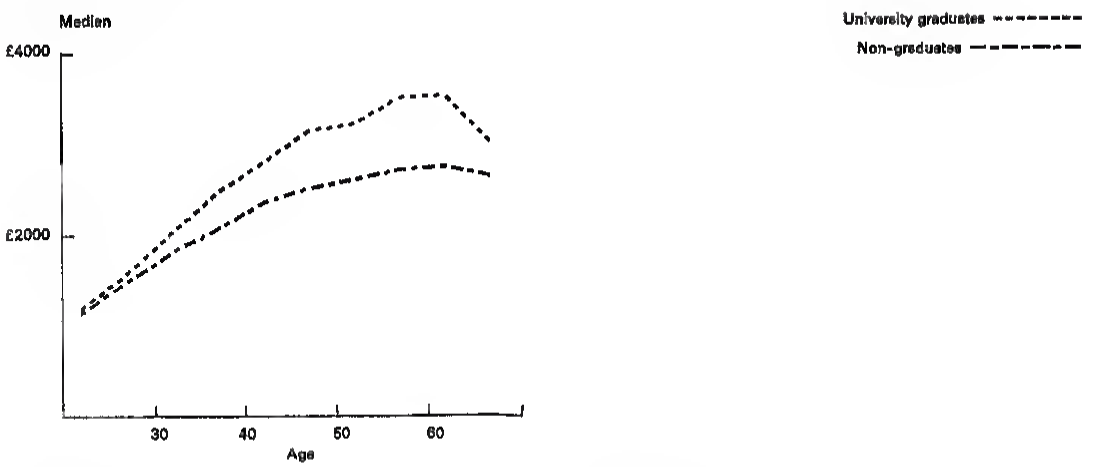
The tables below and the charts opposite show that university graduates have consistently greater incomes than non-graduates. 12 per cent of graduates and 6 per cent of non-graduates have incomes of £4000 and over; while 36 per cent of graduates and 42 per cent of non-graduates had incomes below £2000.

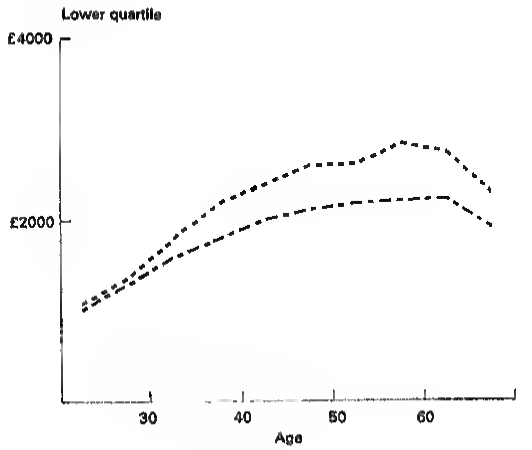
This is the same general position that was found in 1966, but there is a difference between the two years. The difference between the median incomes of graduates and of non-graduates in 1966 was £279; in 1969 this difference was £200. The same tendency is shown by the other measures; the difference in upper quartile income was £585 in 1966, £456 in 1969, in lower quartile incomes was £97 in 1966, £49 in 1969, and so on. The levels of incomes of both graduates and non-graduates had increased but the non-graduates have obtained, in general, greater increases than the graduates.

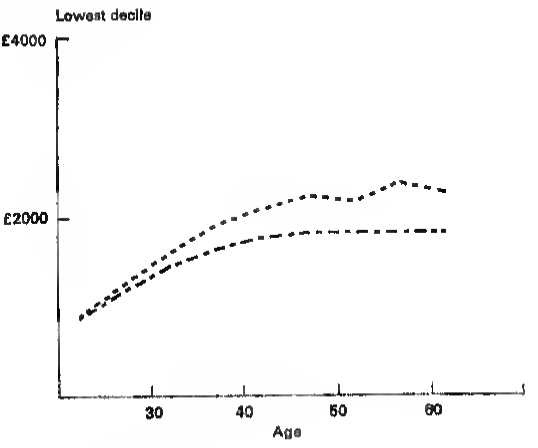
Table 6	Distribution			Cumulative		
	Number	Per cent		Number	Per cent	
		1966	1969		1966	1969
UNIVERSITY GRADUATES						
All engineers	6 667					
Engineers stating income	6 396	*100·0*	*100·0*			
£6000 and above	214	*3·3*	*3·2*	214	*3·3*	*3·2*
£5000 — £5999	160	*2·6*	*2·6*	374	*6·8*	*6·8*
£4000 — £4999	424	*6·6*	*6·0*	798	*12·4*	*11·8*
£3000 — £3999	1 000	*16·6*	*12·1*	1 796	*28·0*	*23·9*
£2000 — £2999	2 363	*36·8*	*33·0*	4 151	*64·8*	*66·9*
£1000 — £1999	2 153	*33·7*	*40·3*	6 304	*98·6*	*97·2*
Below £1000	94	*1·6*	*2·8*	6 398	*100·0*	*100·0*
NON-GRADUATES						
All engineers	11 610					
Engineers stating income	11 476	*100 0*	*100·0*			
£6000 and above	178	*1·6*	*1·4*	176	*1·6*	*1·4*
£5000 — £5999	154	*1·3*	*1·1*	332	*2·9*	*2·6*
£4000 — £4999	398	*3·4*	*2·4*	728	*6·3*	*4·9*
£3000 — £3999	1 242	*10·8*	*6·6*	1 870	*17·1*	*11·4*
£2000 — £2999	4 661	*40·6*	*31·0*	6 621	*57·7*	*42·4*
£1000 — £1999	4 761	*41·4*	*65·8*	11 372	*99·1*	*98·2*
Below £1000	107	*0·9*	*1·8*	11 479	*100·0*	*100·0*

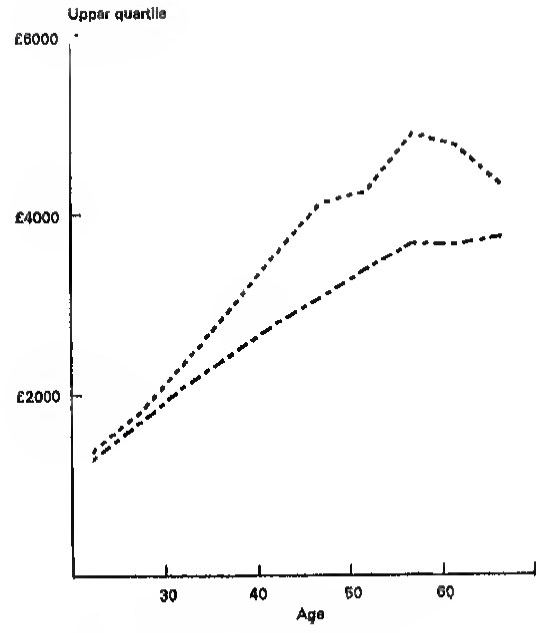
●See also Tables 23 and 24; Questions 5 and 12.

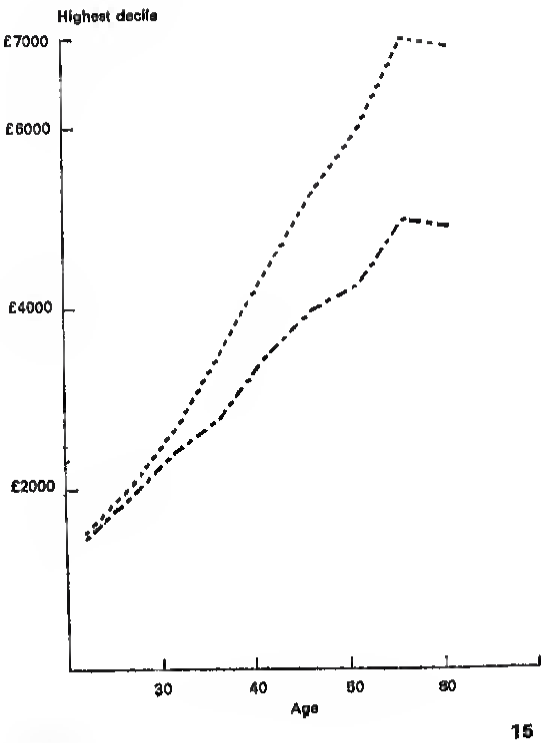
Comparison of university and CNAA graduates and non-graduates











Levels of responsibility

The levels of responsibility as defined below are not suitable for teachers, and they are therefore excluded from all results in this section.

Taking levels D and upwards as involving managerial responsibilities, 62·6 per cent of all engineers are involved in management. Comparison with the 1966 results shows a definite trend to higher responsibilities in 1968: there was a smaller percentage of engineers in each of the three lowest grades, and a greater percentage in each of the higher grades. If this comparison is made by separate age groups, the main movement is found in the lower ages: there have been considerable increases in responsibility for engineers below 40 years, a slight increase for those aged 40 to 49, and practically no change among the older engineers.

Guide to levels of engineering responsibility

	Level A	Level B	Level C
Duties	Preparations of simple plans, designs, calculations, estimating, standards, drawings and other specifications. Routine technical work.	Uses standard engineering techniques for solving problems. Assists more senior engineers with calculations, testing, analysis, design or computation.	Responsible and varied engineering assignments requiring familiarity with a broad field of engineering knowledge. Participates in planning to achieve broad objectives
Recommendations, decisions, and commitments	Routine decisions with ample precedent or with clearly defined procedures as guidance.	Recommendations limited to solution of problem rather than end results. Decisions normally within established guide lines.	Makes independent studies, analyses, judgments and conclusions. Difficult, complex or unusual matters or decisions are usually referred to a higher authority.
Supervision received	Close supervision. Work reviewed for accuracy and adequacy and for conformity with prescribed procedures.	Detailed oral or written instructions on methods and procedures. Results reviewed and technical guidance available.	Work not usually supervised in detail though technical guidance available on unusual or complex problems.
Leadership, authority and/or supervision exercised	May assign and check work of technicians.	May give technical guidance to junior engineers or technicians on a common project.	May give technical guidance to other engineers or technicians assigned to work on a common project. Not normally having continuous responsibility for other engineers.

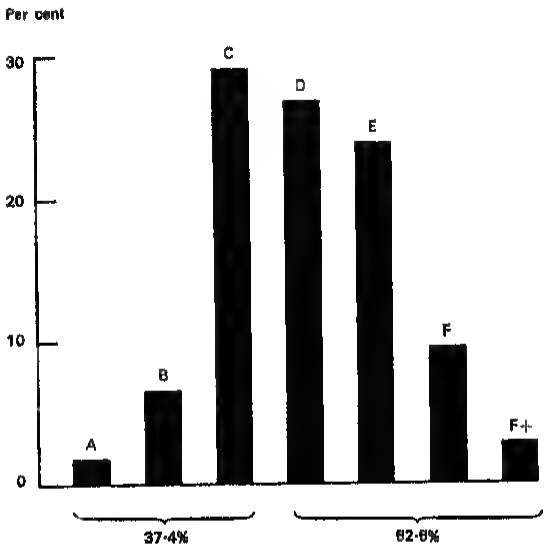


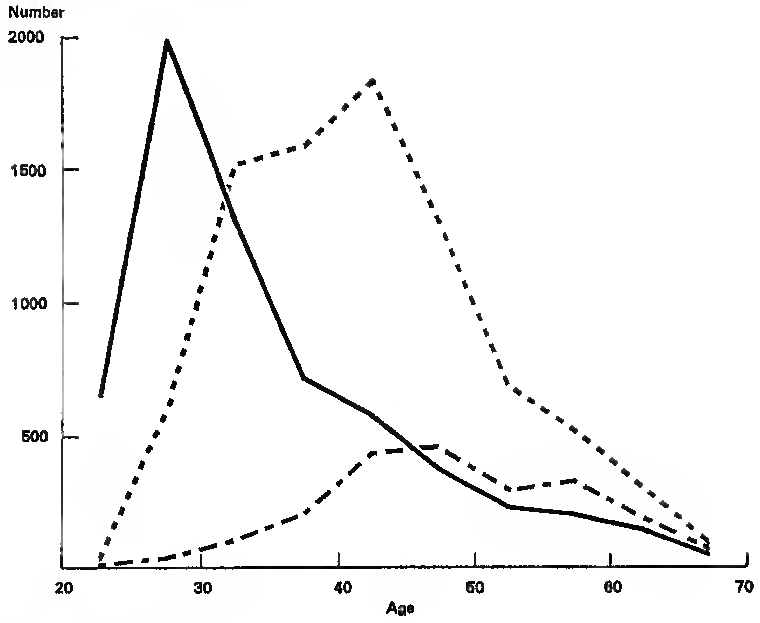
Table 7	Sample number	Per cent 1966	Per cent 1866
All engineers (excluding teachers)	**16 698**	*100·0*	*100·0*
Analysis by level			
A Technical	308	*1·8*	*2·2*
B Engineering	1 087	*6·6*	*6·9*
C Engineering	4 849	*29·0*	*31·3*
D Junior managerial	4 477	*26·8*	*25·8*
E Senior managerial	3 928	*23·5*	*22·3*
F Top managerial	1 591	*9·5*	*8·7*
Beyond F Top managerial	480	*2·8*	*2·7*

●See Tables 25 to 28: Question 16.

Level D	Level E	Level F
First level of direct and sustained supervision of other professional engineers or full specialization. Application of mature engineering knowledge and conducting projects with scope for independent accomplishment.	Usually requires knowledge of more than one field of engineering. Long and short-term planning of projects. Makes independent decisions on work programme. Exercises ingenuity and originality in devising practical and economical solutions to problems. May supervise large groups of professional and technician staff or a small group of highly specialized professional staff.	Exercises administrative responsibility for several groups on interrelated problems. Senior engineering consultant of recognized standing in his field of engineering. Participates in determining major engineering policy.
Recommendations generally reviewed for soundness of judgment but accepted for technical accuracy and practicability.	Makes responsible decisions not usually subject to technical review except those involving large expenditure or long-term objectives. Takes action to implement assigned projects.	Makes responsible decisions on all matters including large expenditure and/or implementation of major programmes subject only to overall policy and financial control.
Work assigned in terms of objectives, relative priorities and critical areas relevant to other projects.	Work assigned only in terms of broad objectives and is only reviewed for policy, soundness of approach and general effectiveness.	Receives administrative direction based on general policy and objectives. Work reviewed only to ensure conformity with policy and co-ordination with other functions.
Assigns and outlines work. Advises on technical problems, reviews work of others for technical accuracy. May have continuous responsibility for other engineers and technicians.	Co-ordinates work programmes and directs use of equipment and materials. Generally makes recommendations on the selection, discipline and remuneration of staff.	Reviews and evaluates engineering work. Co-ordinates to attain overall programme objectives. As an administrator makes decisions on selection, discipline and remuneration of staff.

With acknowledgments to the Canadian Council of Professional Engineers

Levels of responsibility by age



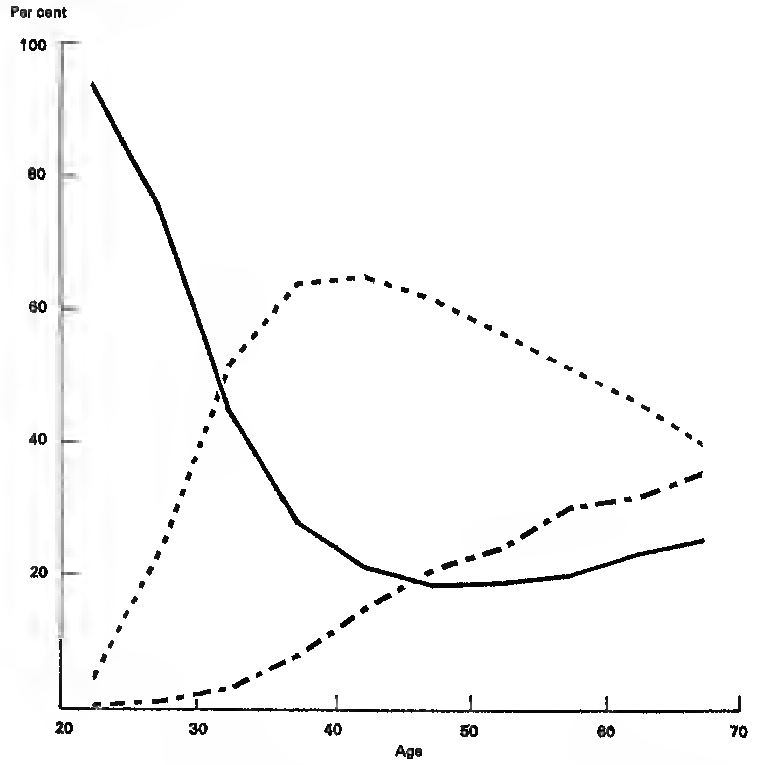


Table 8

	Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
Technical and engineering	555	1 997	1 298	704	579	389	218	199	146	47
Junior and senior managerial	35	607	1 503	1 564	1 611	1 289	575	516	294	74
Top managerial	3	20	100	200	425	437	280	310	199	68

The charts on the opposite page show how levels of responsibility vary with age. The upper chart and the table shows the actual numbers in the sample who ranked themselves within each of the three main groups and, therefore, shows how responsibilities are distributed among engineers.

For age-by-age comparisons, it is necessary to allow for variations in the numbers in each age group, and the second chart does this by showing the percentage of engineers in each age group who were in each of the main groups. Thus, taking the under 26's, the upper chart shows comparatively few in technical and engineering roles; the lower chart shows, however, that this consists of practically the whole of the under 25 group in the survey.

At the other end of the age scale all three lines in the upper chart fall to very small numbers. This is due to the fact that the numbers of engineers in the higher age groups were small. The lower chart allows for this and shows, for example, that from the age of 40 onwards a fairly steady 20 per cent of engineers remain without managerial responsibilities.

Details of the age distribution at each level are given in Tables 26 and 26.

Time at each level of responsibility

The table below shows how long engineers had been at their levels of responsibility. Overall, half of them had spent less than three years there. The proportions were higher still at the lower levels; 60 per cent of those at level A, 76 per cent of those at level B and 67 per cent of those at level C had been there less than three years. The proportions then fell steadily to 31 per cent at level F or beyond.

At the other extreme, 12 per cent of all engineers had been at their level for ten years or longer. On the whole there were smaller percentages in the lower levels (though 15 per cent of those at level A had been there ten years or more) and higher percentages in the top levels. More detail will be found in Tables 27 and 28.

Time at each level of responsibility *Per cent*

Table 9	Total	Less than 3 years	3 years and less than 6	6 years and less than 10	10 years and over
All engineers	**100·0**	**50·0**	**23·2**	**14·7**	**12·2**
Analysis by length of time					
A	100·0	59·6	13·3	11·7	16·4
B	100·0	75·4	12·7	5·8	6·9
C	100·0	56·9	21·5	12·4	9·3
D	100·0	49·6	25·0	14·7	10·8
E	100·0	42·8	28·5	17·7	13·0
F	100·0	36·9	23·5	18·5	22·1
Beyond F	100·0	26·1	24·5	23·1	26·4

Unemployment

The question on unemployment had to distinguish between engineers who were unemployed at the time of the survey and those who had been unemployed during the previous twelve months but who were now again employed. The distinction is important because the latter could record completed periods of unemployment, whereas the former, whose unemployment still continued, could say only how long it had lasted so far. The two categories together, however, give the proportion who had been unemployed at some time during the period of twelve months.

Those still unemployed at the time of the survey amounted to 0·4 per cent of all engineers. This figure can be compared with the national unemployment percentage for the whole working population (not only engineers), since that too is based on a count taken at a particular time. At the beginning and at the end of the period over which questionnaires were being received this total percentage was 2·4 per cent.

Those who had been unemployed during the previous twelve months but were back in employment amounted to 1·1 per cent of all engineers. A quarter of them were working again in less than six weeks, and nearly another quarter in 6 to 10 weeks. This, however, left more than half of them out of employment for 11 weeks or more.

Unemployment is not concentrated in any particular age group but is spread fairly evenly over them.

Table 10	Engineers in sample		Age groups				
	Number	Per cent	Under 30	30-39	40-49	50-59	60 and over
Engineers unemployed at time of survey							
Total	**99**	*100·0*	**9**	**13**	**19**	**16**	**13**
Duration of unemployment (weeks)							
Under 5	14	*20·6*	3	3	6	2	
6 to 10	11	*16·2*	3	2	3	3	
11 to 30	34	*50·0*	3	7	7	7	10
31 to 50	5	*7·4*			1	1	3
51 and over	4	*5·9*		1	1	2	
Engineers unemployed in 1967/68 but re-employed at the time of the survey							
Total	**195***	*100·0*	**49**	**59**	**55**	**24**	**9**
Duration of unemployment (weeks)							
Under 5	49*	*25·1*	11	16	13	4	4
6 to 10	45	*23·1*	5	14	20	5	1
11 to 30	74	*37·9*	27	19	16	10	2
31 to 50	16	*8·2*	3	3	4	5	1
51 and over	11	*5·6*	3	6	2		

* These totals include one engineer who did not state his age.

●See Question 14

Training — engineers taking courses

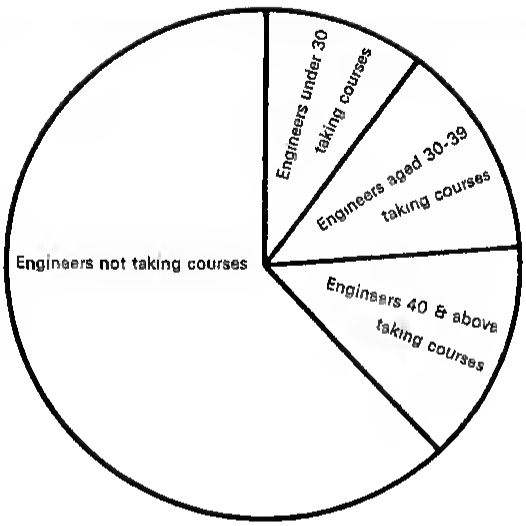


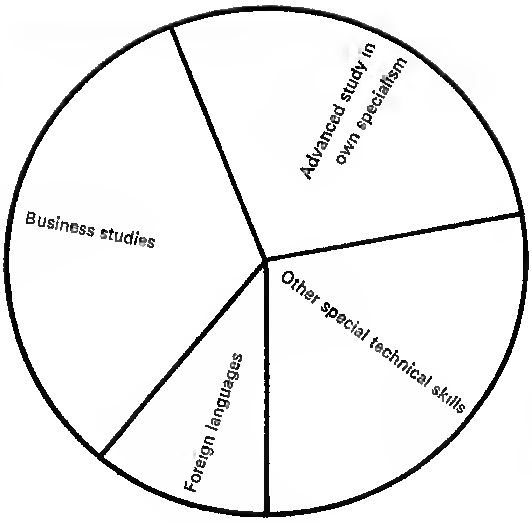
Table 11	Sample number	Engineers taking courses	Engineers taking courses in each age group %
All engineers	**16 497**	**7 061**	*38·2*
Engineers stating age	**16 444**	**7 051**	*38·2*
Under 25	732	458	*62·6*
25 — 29	2 782	1 407	*50·9*
30 — 34	3 202	1 409	*44·0*
35 — 39	2 789	1 135	*40·7*
40 — 44	3 197	1 166	*36·5*
45 — 49	2 375	846	*35·6*
50 — 64	1 306	344	*26·3*
55 — 59	1 134	200	*17·6*
60 and over	947	87	*9·2*

The courses recorded on the questionnaire were taken within the twelve months preceding the survey and were limited to post-experience training. In considering the results, it is necessary to distinguish between numbers of engineers taking courses and the number of courses they took. Many engineers took more than one course, so the number of courses (10 269) is greater than the number of engineers taking them (7 081).

During this period of twelve months, 38 per cent of all engineers took at least one training course. As would be expected, higher proportions of the younger than the older engineers took courses: more than half of those under 30 took courses, and the proportion then drops with age to 9 per cent of those aged over 60.

● See Question 6.

Training — courses taken



Nearly one-third of the courses taken were business studies, including management. These were taken by higher proportions in the older age groups than in the younger ones, but there was still considerable participation even by the youngest engineers: 25 per cent of all courses taken by those under 30 were business studies, compared with 39 per cent of courses taken by those aged 50 and over.

The number of courses concerned with advanced studies in own speciellem and with other technical skills were nearly equal, each accounting for 28 per cent of all courses. On the whole, the younger engineers were more involved in these than the older ones: for example, 37 per cent of the courses taken by engineers aged under 30, and 22 per cent taken by those engineers aged 50 and over, were advanced studies in own specialism.

Compared with these, the number of courses in foreign languages were small, accounting for 11 per cent of all courses taken. They were taken predominantly by older engineers.

Table 12	All courses		Advanced study in own specialism	Other special technical skills	Business studies	Foreign languages
All courses	**10 299**		**2 898**	**2 882**	**3 394**	**1 095**
		%	%	%	%	%
Courses taken by engineers stating age	**10 254**	*100·0*	*28·2*	*28·1*	*33·1*	*10·7*
Under 25	755	*100·0*	*39·2*	*28·4*	*25·8*	*6·6*
25 — 29	2 094	*100·0*	*36·0*	*32·5*	*24·2*	*7·4*
30 — 34	2 032	*100·0*	*29·8*	*27·7*	*33·0*	*9·5*
35 — 39	1 634	*100·0*	*25·4*	*30·3*	*35·3*	*9·1*
40 — 44	1 624	*100·0*	*21·6*	*26·0*	*38·0*	*14·4*
45 — 49	1 206	*100·0*	*22·6*	*25·7*	*39·1*	*12·6*
50 — 54	507	*100·0*	*24·8*	*21·3*	*38·7*	*15·2*
55 — 59	261	*100·0*	*17·8*	*22·1*	*41·3*	*18·9*
60 and over	120	*100·0*	*20·0*	*19·2*	*33·3*	*27·6*

Training—length of courses

Courses in foreign languages were nearly all part-time courses, and they tended to stretch over long periods. Courses in other technical skills split almost equally between full-time and part-time and were mainly comparatively short. The other two classes, advanced studies in own specialism and business studies, involved more full-time than part-time courses, and were mainly comparatively short. In spite of this, however, 24 per cent of the advanced studies and 21 per cent of the business studies courses lasted between nineteen weeks and a full year.

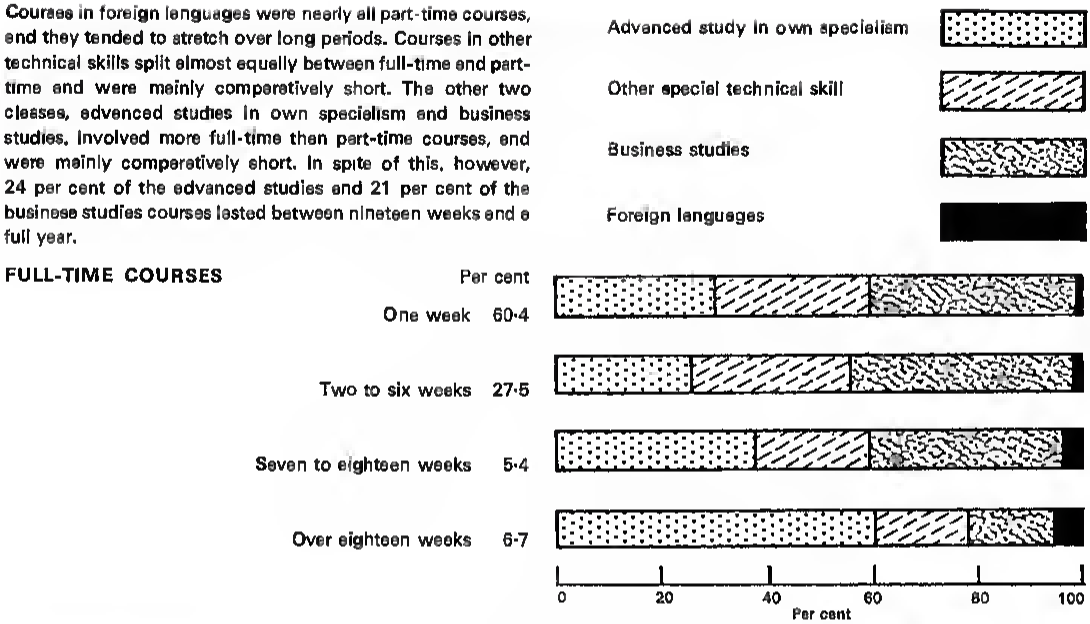


Table 13	All courses		Advanced study in own specialism	Other special technical skills	Business studies	Foreign languages
		%	%	%	%	%
All courses	**10 269**	*100·0*	*28·2*	*28·1*	*33·1*	*10·7*
Full-time	5 163	*100·0*	*32·3*	*28·6*	*38·3*	*0·9*
1 week	3 117	*100·0*	*31·2*	*29·4*	*39·3*	*0·1*
2 to 6 weeks	1 421	*100·0*	*26·4*	*30·7*	*41·7*	*1·2*
7 to 18 weeks	277	*100·0*	*38·3*	*21·7*	*36·4*	*3·6*
Over 18 weeks	348	*100·0*	*61·5*	*17·0*	*16·4*	*5·2*
Part-time	5 106	*100·0*	*24·1*	*27·6*	*27·8*	*20·5*
1 week	1 147	*100·0*	*20·7*	*36·8*	*42·2*	*1·2*
2 to 6 weeks	629	*100·0*	*29·4*	*42·3*	*19·9*	*8·4*
7 to 18 weeks	1 196	*100·0*	*26·7*	*38·9*	*13·1*	*21·3*
Over 18 weeks	2 135	*100·0*	*22·9*	*12·6*	*30·6*	*34·0*

Incomes of engineers and scientists 1968

The charts and tabla overleaf have been prepared jointly by tha Council of Enginaering Institutions and the Council of Scienca end Technology Institutes to illustrate the similarities and diffarances between the profiles of professionai engineers and sciantists.

In 1968 there were parallel surveys of professional engineers and professional scientists.

The constituent members of the Council of Science and Technology Institutes who carried out the parallel survey are :—

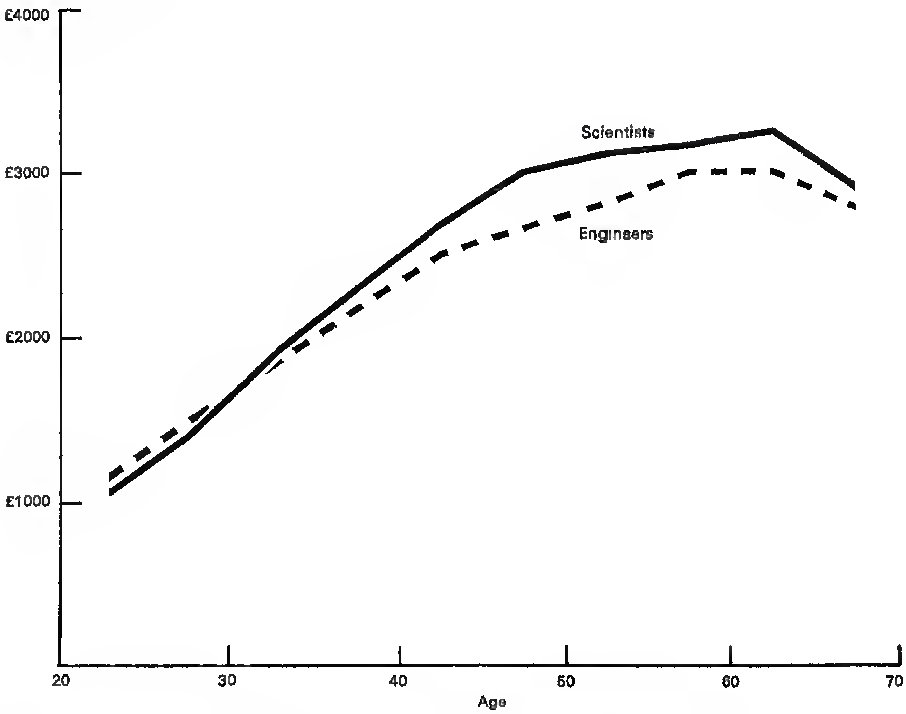
The Institute of Biology
The Royal Institute of Chemistry
The Institute of Mathematics and its Applications
The Institution of Metallurgists
The Institute of Physics and The Physical Society

It had been observed in the 1966 survey of engineers that the university or CNAA graduate earned roughly 15 per cent more than the non-graduate. It follows that, in making a comparison of median incomes, it is important to note that graduates were 71 per cent of the sample of scientists but only 35 per cent of the sample of engineers. This difference largely explains the gap between the age-earning profiles of scientists and engineers shown in the chart below.

It is interesting to see that the upper chart on the opposite page, which compares the median incomes for graduates, shows that age for age there is no significant difference between engineers and scientists for most of the professional career. After age 55, the engineers have the advantage.

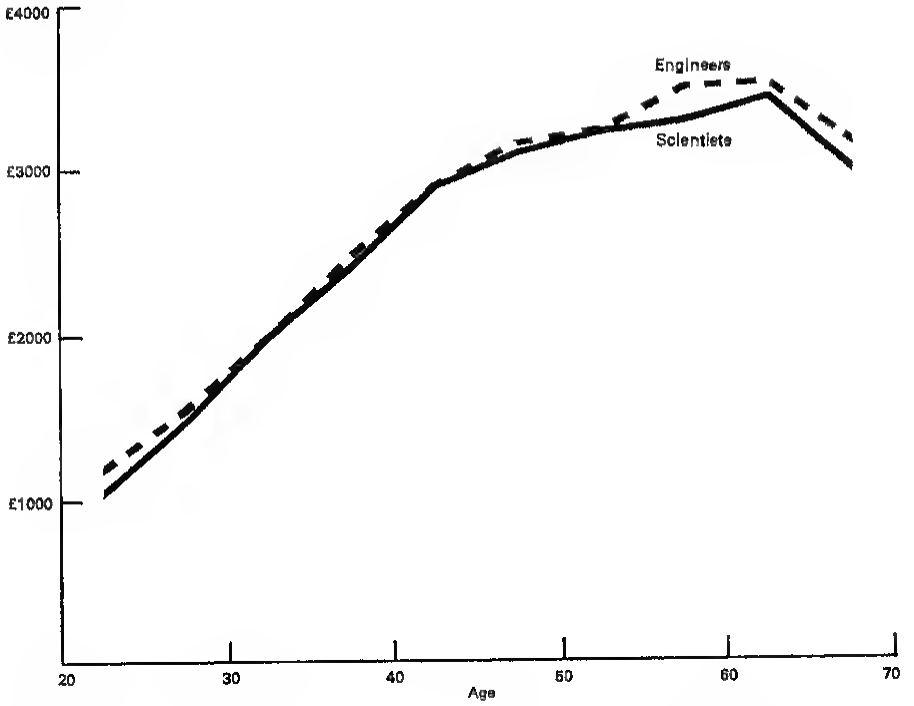
The third chart, on the other hand, shows that the non-graduate engineers have a higher median income than non-graduate scientists. This is explained by historical differences in the method of education and training in the two professional groups. In the past, professional engineers did not require a university degree. Although the position is now changing, the present body of non-graduate engineers has amongst its numbers many senior members of their profession. On the other hand the non-graduate scientists are mainly in supporting roles.

Median incomes of all engineers and scientists in the two surveys

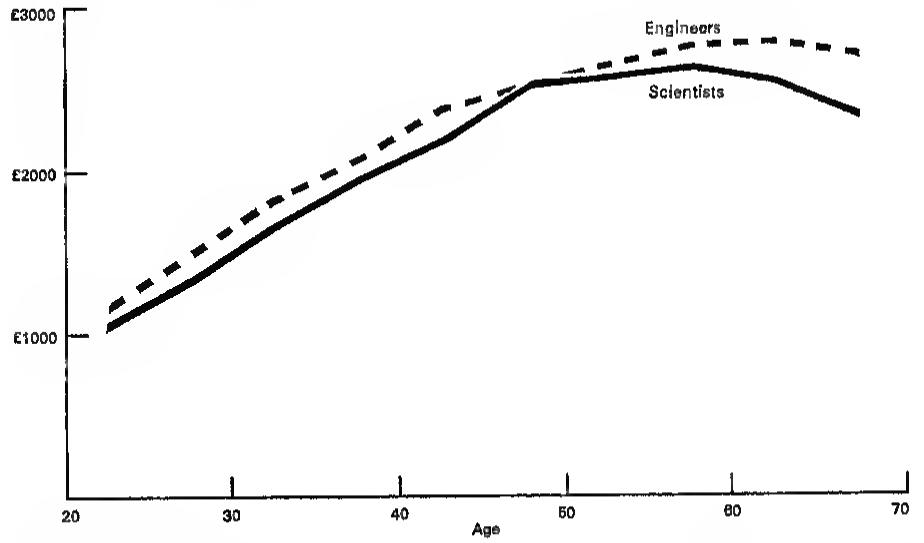


Median incomes of engineers and scientists

With a university or CNAA degree



Without a university or CNAA degree



Median incomes by age

Table 14	Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
	£	£	£	£	£	£	£	£	£	£
All in sample										
Engineers	1151	1500	1889	2185	2500	2855	2800	3000	3000	2789
Scientists	1050	1400	1875	2295	2662	3000	3107	3178	3255	2905
With a university or CNAA degree										
Engineers	1194	1537	2008	2465	2800	3150	3204	3500	3522	3167
Scientists	1050	1485	2011	2430	2800	3107	3210	3290	3423	3000
Without a university or CNAA degree										
Engineers	1130	1485	1800	2052	2340	2500	2603	2704	2730	2692
Scientists	1057	1320	1640	1913	2132	2500	2537	2613	2500	2300

Part two

ALL ENGINEERS IN SAMPLE

Analysis by employer and age

Table 15

	TOTAL		Age groups											Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 and over	
ALL ENGINEERS	**18 497**		**732**	**2 762**	**3 202**	**2 789**	**3 197**	**2 375**	**1 306**	**1 134**	**715**	**189**	**43**	**53**
		%	*4·0*	*15·0*	*17·4*	*15·1*	*17·3*	*12·9*	*7·1*	*6·1*	*3·9*	*1·0*	*0·2*	
Self-employed	541	*2·9*	3	19	46	58	105	90	48	44	57	40	21	10
Employed by														
Central Government	1 112	*6·0*	8	59	113	118	207	220	142	155	74	12	1	3
The Armed Forces	379	*2·1*	7	30	66	77	59	74	41	20	4	1	—	—
Local authority, including colleges and schools	2 779	*15·1*	80	364	461	440	518	328	210	207	144	19	—	10
Nationalized industry or public corporation	2 802	*15·2*	99	399	438	409	498	372	251	211	105	15	1	4
The UK Atomic Energy Authority	310	*1·7*	4	18	23	57	87	73	25	11	12	—	—	—
University	474	*2·6*	20	75	91	67	80	70	23	26	13	6	1	2
Industrial or commercial company or private firm	8 523	*46·3*	425	1 504	1 630	1 334	1 405	1 008	484	385	251	72	8	16
Consultant	1 029	*5·6*	72	231	247	153	141	77	42	27	20	12	4	3
Any other employer	458	*2·5*	12	48	74	74	80	60	29	41	22	10	4	4
Employer not stated	**90**		**1**	**15**	**13**	**2**	**17**	**5**	**11**	**7**	**13**	**2**	**3**	**1**

Analysis by field of work and age

Teble 16

	TOTAL		Aga groups										Aga not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 and over	
ALL ENGINEERS	**18 497**		**732**	**2 762**	**3 202**	**2 789**	**3 197**	**2 376**	**1 306**	**1 134**	**716**	**189**	**43**	**53**
		%	*4·0*	*15·0*	*17·4*	*15·1*	*17·3*	*12·9*	*7·1*	*6·1*	*3·9*	*1·0*	*0·2*	
Manufacturing	7 466	*40·5*	327	1 226	1 455	1 152	1 239	910	450	370	244	64	14	16
Mining and quarrying	387	*2·1*	4	17	52	76	74	*70*	41	35	13	2	1	2
Construction	1 429	*7·8*	96	301	259	203	218	146	81	86	34	11	7	8
Gas, electricity and water	1 792	*9·7*	58	288	261	260	339	216	141	131	81	13	2	3
Transport and communications	924	*5·0*	32	114	148	128	147	141	96	70	38	9	—	1
Municipal engineering	1 420	*7·7*	61	246	235	211	205	139	111	117	84	8	—	3
Research institution, association or station	726	*3·9*	20	87	86	106	147	146	58	47	24	5	—	—
Education	1 670	*8·5*	32	134	271	265	351	239	107	92	57	13	1	8
Central Government administration	321	*1·7*	1	6	*20*	26	58	58	51	67	30	4	—	—
Tha Armed Forces	322	*1·7*	5	30	58	66	50	61	38	11	2	1	—	—
Consulting firms	1 288	*7·0*	74	218	256	194	207	131	59	50	50	34	9	6
Other work	781	*4·2*	17	93	91	101	148	113	64	72	50	21	6	5
Field not stated	**71**		**5**	**3**	**10**	**1**	**14**	**7**	**9**	**6**	**8**	**4**	**3**	**1**

ALL ENGINEERS IN SAMPLE

Analysis by type of work and age

Table 17

	TOTAL		Age groups										Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 and over	
ALL ENGINEERS	**18 497**		**732**	**2 762**	**3 202**	**2 789**	**3 197**	**2 376**	**1 306**	**1 134**	**716**	**189**	**43**	**53**
		%	*4·0*	*15·0*	*17·4*	*15·1*	*17·3*	*12·9*	*7·1*	*6·1*	*3·9*	*1·0*	*0·2*	
General technical administration	4 850	*26·4*	42	298	585	732	984	818	516	485	308	57	9	18
Production	1 677	*9·1*	93	280	365	243	248	208	104	78	42	9	1	8
Instrumentation and control	443	*2·4*	26	105	89	73	85	44	16	14	10	1	—	—
Construction, installation	1 513	*8·2*	86	327	275	207	243	153	89	59	52	14	3	4
Research and development	2 089	*11·4*	134	463	421	284	293	241	101	94	44	9	3	2
Design	3 378	*18·4*	242	793	707	565	466	292	127	101	58	21	2	4
Teaching	1 379	*7·5*	10	102	254	253	323	211	92	71	41	12	2	8
Commercial	926	*5·0*	23	97	136	137	187	140	81	69	39	11	2	4
Consultancy, if not covered in one of the other categories	544	*3·0*	8	53	83	77	104	75	36	33	42	24	9	—
Other engineering occupation	801	*4·4*	35	145	151	125	142	76	50	39	28	7	2	1
Not engineering occupation	751	*4·1*	23	85	118	88	126	97	82	74	36	14	6	4
Type of work not stated	**146**		**10**	**14**	**18**	**5**	**16**	**20**	**12**	**17**	**16**	**10**	**4**	**4**

Analysis by type of work and age

Table 18

	TOTAL		Age groups											Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 and over	
ENGINEERS IN ADMINISTRATIVE OR MANAGERIAL POSITIONS	**11 394**		**150**	**946**	**1 741**	**1 752**	**2 296**	**1 834**	**1 030**	**906**	**556**	**124**	**24**	**35**
		%	*1·3*	*8·3*	*15·3*	*15·4*	*20·2*	*16·1*	*9·1*	*8·0*	*4·9*	*1·1*	*0·2*	
General technical administration	4 564	*40·3*	33	239	538	693	936	787	498	468	294	55	8	15
Production	1 341	*11·8*	35	180	293	204	225	187	98	69	37	7	1	5
Instrumentation and control	202	*1·8*	3	29	47	37	35	31	8	7	4	1	—	—
Construction, installation	942	*8·3*	30	142	164	133	183	129	66	41	39	9	3	3
Research and development	861	*7·6*	8	77	159	133	164	159	69	60	27	5	—	—
Design	1 147	*10·1*	14	118	214	233	235	157	74	58	28	11	2	3
Teaching	381	*3·4*	2	18	49	50	109	78	28	26	16	3	—	2
Commercial	694	*6·1*	10	42	98	101	150	118	68	60	33	8	2	4
Consultancy, if not covered in one of the other categories	295	*2·6*	1	15	36	44	62	51	24	20	27	12	3	—
Other engineering occupation	369	*3·3*	7	44	58	58	88	43	31	24	12	1	2	1
Not engineering occupation	526	*4·6*	7	38	74	62	99	81	64	60	29	8	3	1
Type of work not stated	**72**		**—**	**4**	**11**	**4**	**10**	**13**	**2**	**13**	**10**	**4**	**—**	**1**

ENGINEERS IN SAMPLE IN OTHER POSITIONS

Analysis by type of work and age

Table 19

	TOTAL		Age groups											Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 end over	
ENGINEERS IN OTHER POSITIONS	**7103**		**582**	**1 816**	**1 461**	**1 037**	**901**	**541**	**276**	**228**	**159**	**65**	**19**	**18**
		%	*8·2*	*25·6*	*20·6*	*14·6*	*12·7*	*7·6*	*3·9*	*3·2*	*2·2*	*0·9*	*0·3*	
General technical administration	286	*4·1*	9	59	47	39	48	31	18	17	14	2	1	1
Production	336	*4·8*	58	100	72	39	23	21	6	9	5	2	—	1
Instrumentation and control	241	*3·4*	23	76	42	36	30	13	8	7	6	—	—	—
Construction, installation	571	*8·1*	56	185	112	74	60	24	23	18	13	5	—	1
Research end development	1 228	*17·5*	126	386	262	151	129	82	32	34	17	4	3	2
Design	2 231	*31·7*	228	675	493	332	231	135	53	43	30	10	—	1
Teeching	998	*14·2*	8	64	205	203	214	133	64	45	25	9	2	8
Commercial	232	*3·3*	13	55	38	36	37	22	13	9	8	3	—	—
Consultancy, if not covered in one of the other categories	249	*3·5*	7	38	47	33	42	24	12	13	15	12	6	—
Other engineering occupation	432	*6·1*	28	101	93	67	54	33	19	15	16	8	—	—
Not engineering occupation	225	*3·2*	16	47	42	26	27	16	18	14	7	6	3	3
Type of work not stated	74		10	10	8	1	6	7	10	4	5	6	4	3

Analysis by field of work and type of work

Table 20

	TOTAL		General technical admin.	Production	Instrumentation and control	Construction installation	Research and development	Design	Teaching	Commercial	Consultancy	Other engineering	Not engineering	Type of work not stated
ALL ENGINEERS	**18 497**		**4 850**	**1 677**	**443**	**1 513**	**2 089**	**3 378**	**1 378**	**926**	**544**	**801**	**751**	**146**
		%	*26·4*	*9·1*	*2·4*	*8·2*	*11·4*	*18·4*	*7·5*	*5·0*	*3·0*	*4·4*	*4·1*	
Manufacturing														
Total	**7 466**	*40·5*	**1 776**	**1 203**	**253**	**266**	**1 201**	**1 432**	**22**	**623**	**105**	**318**	**225**	**42**
Chemical or allied manufacture	1 021	*5·5*	267	184	56	69	118	179	1	43	13	67	31	3
Metal manufacture	279	*1·5*	87	60	6	10	38	21	1	20	6	12	18	1
Machine tools manufacture	212	*1·2*	69	46	1	2	14	62	—	22	4	7	1	4
Industrial plant or steelwork	536	*2·9*	172	58	10	28	36	124	1	88	6	21	6	4
Other mechanical engineering	957	*5·2*	259	142	12	27	101	218	2	89	16	61	26	2
Electrical machinery or equipment	716	*3·9*	132	107	37	22	96	153	3	119	7	22	14	4
Electronic or telecommunication apparatus	1 306	*7·1*	211	155	74	26	417	216	3	116	11	30	38	8
Shipbuilding or marine engineering	425	*2·3*	146	44	6	40	23	71	3	30	12	36	12	3
Aircraft or aero-engine manufacture	686	*3·7*	119	92	22	7	169	207	3	18	7	15	25	2
Vehicle manufacture	376	*2·0*	86	78	5	6	57	94	3	17	8	14	8	2
Other manufacturing	950	*5·2*	238	239	24	30	130	97	2	79	14	44	44	9
Mining and quarrying	**387**	*2·1*	**112**	**167**	**3**	**7**	**30**	**15**	—	**11**	**6**	**23**	**12**	**1**
Construction—building, civil engineering, contracting	**1 429**	*7·8*	**299**	**37**	**10**	**591**	**43**	**328**	**2**	**74**	**11**	**16**	**18**	**2**

ALL ENGINEERS IN SAMPLE

Analysis by field of work and type of work

Table 20—continued

	TOTAL	%	General technical admin.	Production	Instrumentation and control	Construction installation	Research and development	Design	Teaching	Commercial	Consultancy	Other engineering	Not engineering	Type of work not stated
Public utilities–Total	4 136	*22·4*	1 747	180	104	478	190	851	24	116	33	298	81	32
Gas production or distribution	308	*1·7*	124	70	10	28	14	12	—	28	4	11	6	1
Electricity generating or distribution	1 300	*7·1*	458	81	64	239	64	158	4	59	9	116	24	4
Water supply	164	*1·0*	96	4	2	22	3	48	—	—	1	6	—	2
Transport (by rail, road, air, water)	523	*2·8*	244	19	4	24	34	49	2	28	11	72	30	6
Docks, harbours, inland waterways	71	*0·4*	39	—	—	12	2	7	—	1	—	5	4	1
Municipal engineering	1 420	*7·7*	656	3	—	120	13	555	3	—	4	47	4	15
Postal services, telecommunications or broadcasting	330	*1·8*	130	3	4	33	60	22	16	2	4	41	13	3
Research—research institution, association or station	726	*3·9*	81	13	32	17	446	102	6	—	7	6	14	2
Education–Total	1 570	*8·5*	80	2	7	2	84	13	1 285	—	3	7	78	9
University	528	*2·9*	23	2	6	1	81	11	375	—	2	4	17	6
Technical college or training college	995	*5·4*	57	—	1	1	3	2	882	—	1	3	43	2
School	47	*0·3*	—	—	—	—	—	—	28	—	—	—	18	1
Public administration and defence–Total	643	*3·5*	408	16	7	11	44	19	23	3	9	29	71	3
Central Government administration	321	*1·7*	203	11	6	10	23	16	1	3	5	14	29	1
The Armed Forces	322	*1·7*	205	5	2	1	21	3	22	—	4	15	42	2
Consulting firms	1 288	*7·0*	163	24	16	111	12	555	3	12	330	9	48	5
Other fields	781	*4·2*	173	33	11	28	36	62	12	81	38	94	201	12
Field not stated	71		11	2	—	2	3	1	2	4	2	1	5	38

Analysis by field of work and employer

Teble 21

	TOTAL		Self employed	Central Govem-ment	Armed Forces	Local authority	Nationel-ized industry*	UKAEA	University	Industrial or com-mercial company or private firm	Consul-tant	Any other employer	Employer not stated
ALL ENGINEERS	**18 497**		**541**	**1 112**	**379**	**2 779**	**2 802**	**310**	**474**	**8 523**	**1 029**	**458**	**90**
		%	*2·9*	*6·0*	*2·1*	*15·1*	*15·2*	*1·7*	*2·6*	*46·3*	*5·6*	*2·5*	
Menufacturing industry	7 466	*40·5*	139	208	21	8	203	77	5	6 660	21	103	21
Mining and quarrying	387	*2·1*	3	17	—	1	286	2	—	69	2	7	—
Construction	1 429	*7·8*	50	88	—	119	88	12	2	986	46	34	4
Gas, electricity end water	1 792	*9·7*	7	11	—	131	1 482	31	—	103	4	18	7
Transport and communication	924	*5·0*	4	50	8	40	569	—	—	201	1	49	2
Municipal engineering	1 420	*7·7*	—	10	1	1 389	14	—	—	1	—	2	3
Research institution, association or station	726	*3·9*	—	321	12	—	81	162	4	70	1	73	2
Education	1 570	*8·5*	—	21	11	1 038	8	1	461	7	1	21	3
Central Govemment administration	321	*1·7*	—	308	4	—	6	—	—	—	—	3	1
Armed Forces	322	*1·7*	—	1	319	—	—	—	—	1	—	—	1
Consulting firms	1 288	*7·0*	260	6	—	2	5	4	—	43	950	17	1
Other work	781	*4·2*	75	67	3	49	59	21	1	371	3	129	3
Field not stated	**71**		**3**	**4**	**—**	**4**	**2**	**—**	**1**	**11**	**—**	**4**	**42**

*Nationalized industry or public corporation including GPO, BBC, NPA, etc.

Analysis by income and age

Table 22

	TOTAL		Age groups										Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 and over	
ALL ENGINEERS	18 497		732	2 762	3 202	2 789	3 197	2 375	1 306	1 134	715	189	43	53
		%	*4·0*	*15·0*	*17·4*	*15·1*	*17·3*	*12·9*	*7·1*	*6·1*	*3·9*	*1·0*	0·2	
Below £1 000	201	*1·1*	120	52	8	3	3	1	3	3	1	5	2	—
£1 000—1 199	463	*2·6*	225	184	27	5	4	4	6	1	2	2	1	1
£1 200—1 399	1 041	*5·8*	177	518	143	41	21	16	8	8	1	5	2	1
£1 400—1 599	1 537	*8·6*	70	745	402	136	62	41	31	26	17	3	1	3
£1 600—1 799	2 014	*11·2*	16	563	698	339	167	105	51	42	24	6	2	1
£1 800—1 999	1 849	*10·3*	4	254	817	389	269	153	69	53	28	9	1	3
£2 000—2 499	4 355	*24·4*	3	209	910	1 019	987	589	282	206	121	15	2	12
£2 500—2 899	2 649	*14·8*	—	30	232	489	735	586	257	191	123	20	—	6
£3 000—3 999	2 242	*12·5*	—	11	91	243	597	502	321	280	185	19	3	10
£4 000—4 999	820	*4·6*	1	—	10	58	174	193	149	127	89	18	1	2
£5 000—5 999	314	*1·8*	—	—	3	20	61	86	38	61	34	7	2	2
£6 000 and over	392	*2·2*	1	1	—	10	64	88	62	96	53	11	2	4
Income not stated	620		115	95	61	38	53	31	29	40	57	89	24	8
	£		£	£	£	£	£	£	£	£	£	£		
Lowest decile	1 411		895	1 200	1 470	1 662	1 850	1 877	1 874	1 875	1 939	1 311		
Lower quartile	1 722		1 020	1 340	1 650	1 865	2 100	2 220	2 271	2 334	2 354	1 915		
Median	2 185		1 151	1 500	1 869	2 185	2 500	2 655	2 800	3 000	3 000	2 789		
Upper quartile	2 796		1 300	1 715	2 167	2 550	3 037	3 407	3 800	4 000	4 000	4 156		
Highest decile	3 748		1 485	1 964	2 500	3 028	3 848	4 400	4 677	5 549	5 500	5 510		

Analysis by income and age

Table 23

	TOTAL		Age groups											Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 and over	
GRADUATE ENGINEERS	**6 667**		**407**	**1 378**	**1 137**	**850**	**1 145**	**703**	**388**	**350**	**235**	**65**	**16**	**13**
		%	*6·1*	*20·6*	*17·0*	*12·7*	*17·2*	*10·5*	*5·8*	*5·2*	*3·5*	*1·0*	*0·2*	
Below £1 000	94	*1·5*	51	35	3	2	1	—	1	—	—	1	—	—
£1 000—1 199	189	*3·0*	118	80	8	1	1	—	—	—	1	1	1	—
£1 200—1 399	420	*6·6*	101	291	19	3	—	—	2	1	1	—	1	1
£1 400—1 599	483	*7·5*	39	353	63	16	3	2	1	3	1	1	1	—
£1 600—1 799	549	*8·6*	10	285	175	36	20	8	7	2	3	2	—	1
£1 800—1 999	512	*8·0*	2	139	227	53	52	18	13	4	1	2	1	—
£2 000—2 499	1 377	*21·5*	2	121	451	319	257	108	47	35	29	4	1	3
£2 500—2 999	976	*15·3*	—	19	111	213	307	159	77	55	28	7	—	—
£3 000—3 999	1 000	*15·6*	—	8	52	143	309	195	112	104	64	8	1	4
£4 000—4 999	424	*6·6*	1	—	6	35	110	107	62	56	39	9	—	—
£5 000—5 999	160	*2·5*	—	—	1	11	36	44	19	27	20	1	1	1
£8 000 and over	214	*3·3*	1	1	—	3	34	51	37	54	28	6	—	1
Income not stated	289		84	66	21	16	16	11	10	10	22	23	9	2
	£		£	£	£	£	£	£	£	£	£	£		
Lowest decile	1 365		897	1 225	1 600	1 900	2 082	2 221	2 149	2 361	2 256	*		
Lower quartile	1 748		1 056	1 353	1 800	2 161	2 380	2 582	2 600	2 856	2 757	2 125		
Median	2 300		**1 194**	**1 537**	**2 009**	**2 465**	**2 800**	**3 150**	**3 204**	3 500	3 522	**3 167**		
Upper quartile	3 080		1 326	1 750	2 300	2 900	3 500	4 100	4 213	4 873	4 731	4 528		
Highest decile	4 194		1 500	2 000	2 650	3 500	4 400	5 250	5 939	7 000	6 900	*		

*Numbers in these groups are too small to justify calculation of deciles.

ENGINEERS IN SAMPLE WITHDUT A UNIVERSITY OR CNAA DEGREE

Analysis by income and age

Table 24

	TOTAL		Age groups											Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-54	65-69	70 and over	
NON-GRAOUATE ENGINEERS	11 810		325	1 384	2 065	1 939	2 052	1 672	918	784	480	124	27	40
		%	*2·8*	*11·8*	*17·5*	*16·5*	*17·4*	*14·2*	*7·8*	*6·7*	*4·1*	*1·1*	*0·2*	
Below £1 000	107	*0·9*	69	17	5	1	2	1	2	3	1	4	2	—
£1 000—1 199	274	*2·4*	109	124	19	5	3	4	6	1	1	1	—	1
£1 200—1 399	621	*5·4*	76	327	124	38	21	16	6	7	—	5	1	—
£1 400—1 599	1 054	*9·2*	31	392	339	120	59	39	30	23	18	2	—	3
£1 600—1 799	1 465	*12·8*	6	278	523	303	147	97	44	40	21	4	2	—
£1 800—1 999	1 337	*11·6*	2	115	390	336	217	135	56	49	27	7	—	3
£2 000—2 499	2 978	*25·9*	1	88	459	700	730	481	235	171	92	11	1	9
£2 500—2 999	1 673	*14·6*	—	11	121	276	428	407	180	136	95	13	—	6
£3 000—3 999	1 242	*10·8*	—	3	39	100	288	307	209	176	101	11	2	6
£4 000—4 999	396	*3·4*	—	—	4	21	64	86	87	72	50	9	1	2
£5 000—5 999	154	*1·3*	—	—	2	9	26	42	19	34	14	8	1	1
£8 000 and over	178	*1·6*	—	—	—	7	30	37	25	42	27	6	2	3
Income not stated	331		31	29	40	23	37	20	19	30	36	46	15	6
	£		£	£	£	£	£	£	£	£	£	£		
Lowest decile	1 420		895	1,191	1 435	1 611	1 750	1 800	1 800	1 800	1 800	1 267		
Lower quartile	1 700		1 000	1 300	1 600	1 800	2 000	2 106	2 171	2 200	2 222	1 843		
Median	2 100		1 130	1 485	1 800	2 052	2 340	2 500	2 603	2 704	2 730	2 692		
Upper quartile	2 825		1 258	1 685	2 050	2 400	2 759	3 050	3 350	3 628	3 619	4 160		
Highest decile	3 500		1 457	1 890	2 400	2 779	3 491	3 978	4 259	4 979	4 880	5 714		

ENGINEERS IN SAMPLE WHO STATED LEVEL OF RESPONSIBILITY[1]

Analysis by level and age

Table 25

	TOTAL		Age groups											Age not stated
			Under 25	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70 and over	
ENGINEERS WHO STATED LEVEL	16 698		693	2 624	2 901	2 488	2 815	2 115	1 173	1 025	638	159	30	37
Analysis by level		*%*	*4·2*	*15·7*	*17·4*	*14·9*	*16·9*	*12·7*	*7·0*	*6·2*	*3·8*	*1·0*	*0·2*	
A	306	*1·8*	82	71	41	19	23	15	17	16	13	6	2	1
B	1 087	*6·5*	294	430	163	59	43	38	28	22	12	6	1	1
C	4 849	*29·0*	279	1 496	1 104	626	513	336	173	161	120	26	8	9
D	4 477	*26·8*	27	479	995	897	880	536	283	214	127	26	6	7
E	3 928	*23·5*	8	128	508	687	931	753	392	302	167	36	6	10
F	1 591	*9·5*	3	17	84	171	334	341	211	239	140	42	4	5
Beyond F	460	*2·8*	—	3	18	29	91	96	69	71	59	17	5	4

[1]Teachers were not asked to answer this question.

ENGINEERS IN SAMPLE WHO STATED LEVEL OF RESPONSIBILITY

Percentage analysis by level and age

Per cent

Table 26

	TOTAL	Age groups										
		Under 25	25-29	30-34	35-39	40-44	46-49	50-54	55-59	60-64	65-69	70 and over
ENGINEERS WHO STATED LEVEL	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
Analysis by level												
A	1·8	11·8	2·7	1·4	0·8	0·8	0·7	1·4	1·6	2·0	3·8	6·7
B	6·5	42·4	16·4	5·3	2·4	1·5	1·8	2·4	2·1	1·9	3·8	3·3
C	29·0	40·3	57·0	38·1	25·2	18·2	15·9	14·7	16·7	18·8	16·4	20·0
D	28·8	3·9	18·3	34·3	36·1	31·3	25·3	24·1	20·9	19·9	16·4	20·0
E	23·5	1·2	4·9	17·5	27·6	33·1	35·6	33·4	29·5	26·2	22·6	20·0
F	9·5	0·4	0·6	2·9	6·9	11·9	16·1	18·0	23·3	21·9	26·4	13·3
Beyond F	2·8	—	0·1	0·6	1·2	3·2	4·5	5·9	8·9	9·2	10·7	18·7
ENGINEERS WHO STATED LEVEL	100·0	4·2	15·7	17·4	14·9	16·9	12·7	7·0	6·2	3·8	1·0	0·2
Analysis by age												
A	100·0	26·9	23·3	13·4	6·2	7·5	4·9	5·6	5·2	4·3	2·0	0·7
B	100·0	27·1	39·6	14·1	5·4	4·0	3·5	2·6	2·0	1·1	0·6	0·1
C	100·0	5·8	30·9	22·8	12·9	10·6	8·9	3·6	3·3	2·5	0·5	0·1
D	100·0	0·6	10·7	22·3	20·1	19·7	12·0	6·3	4·8	2·8	0·6	0·1
E	100·0	0·2	3·3	13·0	17·5	23·8	19·2	10·0	7·7	4·3	0·9	0·2
F	100·0	0·2	1·1	5·3	10·8	21·1	21·5	13·3	15·1	8·8	2·6	0·3
Beyond F	100·0	—	0·7	3·5	6·4	20·0	21·1	15·1	15·8	12·9	3·7	1·1

Analysis of level of responsibility by length of time at that level

Table 27	TOTALS		Less than 1 year	1 year and less than 2 years	2 years and less than 3 years	3 years and less than 4 years	4 years and less than 5 years	6 years and less than 6 years	6 years and less than 7 years	7 years and less than 8 years	8 years and less than 9 years	9 years and less than 10 years	10 years and over	Length of time not stated
ALL ENGINEERS[1]	**18 698**		**2 436**	**2 933**	**2 194**	**1 488**	**1 300**	**720**	**514**	**628**	**216**	**872**	**1 846**	**1 551**
Analysis by level		*%*	*16·1*	*19·4*	*14·5*	*9·8*	*8·6*	*4·8*	*3·4*	*4·1*	*1·4*	*5·8*	*12·2*	
A	306	*1·8*	76	81	30	19	10	8	14	6	2	11	43	26
8	1 087	*6·5*	321	290	125	60	45	19	16	13	7	21	58	112
C	4 849	*29·0*	801	1 005	675	422	361	154	123	159	51	209	405	484
D	4 477	*26·8*	629	765	615	434	352	225	131	158	53	254	438	423
E	3 928	*23·5*	429	572	527	386	362	199	145	184	64	237	462	361
F	1 591	*9·5*	148	200	183	139	122	87	57	81	30	106	328	110
8eyond F	460	*2·8*	32	40	39	28	48	28	28	27	9	34	112	35

[1]Teachers were not asked to answer this question

ENGINEERS IN SAMPLE WHO STATED LEVEL OF RESPONSIBILITY

Percentege analysis of levels of responsibility by length of time at that level

Per cent

Teble 28

	TOTALS	Less than 1 year	1 year and less than 2 years	2 years and less than 3 years	3 years end less than 4 years	4 years and less than 5 years	5 years end less than 6 years	6 years and less than 7 years	7 years and less than 8 years	8 years and less than 9 years	9 years and less than 10 years	10 years and over
ALL ENGINEERS	100·0	100·0	100·0	100 0	100·0	100·0	100 0	100·0	100·0	100·0	100·0	100·0
Analysis by level												
A	1·6	3·1	2·1	1·4	1·3	0·8	1·1	2·7	1·0	0·9	1·3	2·3
8	8·6	13·2	9·9	5·7	4·0	3·6	2·8	3·1	2·1	3·2	2·4	3·1
C	29·0	32·9	34·3	30·8	28·4	27·6	21·4	23·9	25·3	23·6	24·0	21·9
D	26·6	25·8	26·1	28·0	29·2	27·1	31·3	25·5	25·2	24 5	29·1	23·7
E	23·6	17·6	19·5	24·0	25·9	27·8	27·6	28·2	29·3	29·6	27·2	25 0
F	9·5	8·1	6·8	8·3	9·3	9·4	12·1	11·1	12·9	13·9	12·2	17·8
8eyond F	2·8	1·3	1·4	1 8	1·9	3·7	3·9	5·4	4·3	4·2	3·9	6·1
ALL ENGINEERS	100·0	16·1	19·4	14 5	9·8	8·6	4·8	3·4	4 1	1·4	6·8	12·2
Analysis by length of time at level												
A	100·0	27·1	21·8	10·7	5·8	3·6	2·9	5·0	2·1	0·7	3·9	15·4
8	100·0	32·9	29·7	12·6	8·2	4·6	1·9	1·6	1·3	0·7	2·2	5·9
C	100·0	18·4	23·0	15·6	9·7	6·3	3·S	2·8	3·6	1·2	4·8	9·3
D	100·0	15·5	16·9	16·2	10·7	8·7	5·6	3·2	3·9	1·3	6·3	10·8
E	100·0	12·0	16·0	14·8	10·8	10·1	5·8	4·1	5·2	1·6	6·8	13·0
F	100·0	10·0	13·5	12·4	9·4	8·2	5·8	3·8	S·5	2·0	7·2	22·1
8eyond F	100·0	7·5	9·4	8·2	6·6	11·3	8·6	6·6	6·4	2·1	8·0	26·4

MEMBERSHIP OF THE ENGINEERING INSTITUTIONS
WITHIN THE COUNCIL OF ENGINEERING INSTITUTIONS
End December 1958

Table 29

	Total home and overseas members	Home members		
		Corporate and graduate	Corporate	Graduate
The Royal Aeronautical Society	8 467	6 579	5 568	1 011
The Institution of Chemical Engineers	7 281	5 333	2 970	2 363
The Institution of Civil Engineers	32 426	24 931	18 768	6 163
The Institution of Electrical Engineers	52 115	41 797	23 535	18 262
The Institution of Electronic and Radio Engineers	9 581	8 101	3 787	4 314
The Institution of Gas Engineers	3 440	3 217	3 061	156
The Institute of Merine Engineers	13 439	9 742	8 921	821
The Institution of Mechanical Engineers	63 569	54 355	36 426	17 929
The Institution of Mining and Metallurgy	2 518	883	883	—
The Institution of Mining Engineers	3 819	3 469	3 469	—
The Institution of Municipal Engineers	6 814	6 320	6 320	—
The Royal Institution of Naval Architects	3 947	2 839	2 839	—
The Institution of Production Engineers	14 579	12 306	9 072	3 234
The Institution of Structural Engineers	11 557	8 391	6 848	2 543

How the survey was conducted

For the purposes of the survey, professionel engineers ere defined es corporete members or graduete members (or the equivalent of that grade of membership) of the fourteen institutions which form the Council of Engineering Institutions. The sample used in the survey was drawn from these engineers but was confined to the United Kingdom, those members resident abroed being excluded.

The deteiled information needed from the survey required e semple of about 25 000. Its distribution emong the institutions and between the grades of membership wes in proportion to membership end grede numbers.

Envelopes for use in the survey were sddressed by the institutions from their lists, using the formula 'Stert et the Xth neme end then take every seventh neme thereefter throughout the list of home corporete and greduate (or equivelent grede) members.' The sterting point, X, for eech institution was taken from e list of rendom numbers. This geve 25 835 nemes end eddresses.

Questionneires were despetched on 4 and 5 November 1968, and the survey wes closed on 18 April 1969. By then, some 21 000 replies hed been received.

Not all of these could be used. Rejections included retired engineers, those from oversees who either ueed a home address or who hed gone oversees since the envelopes were addressed, students and treinees, end so on. Questionneires from semi-retired engineers were reteined but their incomes were excluded. This left 18 497 questionneires in analysis.

The response rate was 79·8 per cent.

The number who did not complete questionneires was 4654.

SURVEY OF PROFESSIONAL ENGINEERS

FOREWORD by the Chairman of the Council of Engineering Institutions,
Sir Leonard Drucquer, C.Eng.

In 1966 was carried out tbe first comprehensive survey of the engineering profession. The first results were published in September 1967 and provided more information than exists on any other profession in the country. It pointed to possible trends in employment with implications for the wellbeing of the individual, industry and the country. One survey is not, however, enough to confirm tbe existence of trends and it has been decided that a further such survey must be carried out in 1968.

In the last Survey, the response from engineers was outstanding and I hope that for this survey there will be similar support from the profession. Every single reply to this questionnaire is important; the reliability of the results depends upon the proportion of completed questionnaires returned. Please co-operate by answering the questions and returning your completed questionnaire as soon as possible in the envelope provided.

We have taken precautions to preserve anonymity and the identity of respondents will not be disclosed in any circumstances.

This questionnaire is being sent to a sample of the members of the professional engineering institutions. If you are a member of more than one of these Institutions you may receive more thon one copy of this questionnaire. Should that happen, please complete one of them, mark the other (or others) 'Duplicate', and return them together in one of the envelopes provided.

ANONYMITY

A note by the Consultant in charge of the Survey

In order to send out reminders to those wbo have not returned their questionnaires, I must be able to identify those who reply. This is the purpose of the serial numbers on the front of the questionnaires. I must make sure that this number is used only in removing from the reminder file the names of those wbo have replied, and that it is not used to connect answers (particularly the one concerning income) with the individual who supplied them.

The only occasion when a questionnaire and the name of the person who completed it could come together is when the name is being removed from the reminder file. I must prevent this from happening, so the reminder file will be kept in another building to which tbe members of my staff who handle questionnaires will not have access. Numbers on returned questionnaires will be listed and the list will be sent to the people wbo work on the reminder file in the other building. Thus those who see the questionnaires will never see names and addresses, and those who do see names and addresses will never handle questionnaires.

Once the reminders have been posted, all records of names and addresses will be destroyed. It will then be impossible for anyone to discover who completed a questionnaire.

Tbese precautions seem adequate to me, but if you are not convinced, then by cutting from the front page of the questionnaire the corner with the number on it, you will remove the only means by which you can be identified. But if you do this your name will, of course, remain in the reminder file, and you must not be annoyed with me when you receive reminders.

CHRISTOPHER SCARAOROUGH

PART I GENERAL

1. Please indicate by ringing the appropriate number or numbers below whether you are a Member (or equivalent), an Associate Member (or equivalent) or a Graduate Member (or equivalent) of any of the Institutions listed.

	Member	*Associate Member*	*Graduate Member*
The Royal Aeronautical Society	1A	2A	3A
The Institution of Chemical Engineers	1B	2B	3B
The Institution of Civil Engineers	1C	2C	3C
The Institution of Electrical Engineers	1D	2D	3D
The Institution of Electronic and Radio Engineers	1E	2E	3E
The Institution of Gas Engineers	1F	2F	3F
The Institute of Marine Engineers	1G	2G	3G
The Institution of Mechanical Engineers	1H	2H	3H
The Institution of Mining and Metallurgy	1J	2J	
The Institution of Mining Engineers	1K	2K	
The Institution of Municipal Engineers	1L	2L	
The Royal Institution of Naval Architects	1M	2M	
The Institution of Production Engineers	1N	2N	3N
The Institution of Structural Engineers	1P	2P	3P

2. Please underline the year in which you were born in the table below.

1944 or later	1943 1942 1941 1940 1939	1938 1937 1936 1935 1934	1933 1932 1931 1930 1929	1928 1927 1926 1925 1924	1923 1922 1921 1920 1919	1918 1917 1916 1915 1914	1913 1912 1911 1910 1909	1908 1907 1906 1905 1904	1903 1902 1901 1900 1899	1898 or earlier
A	B	C	D	E	F	G	H	J	K	L

The 'financial year' referred to in the two questions which follow is the year ended on 5 April 1968.

3. If you were retired or partially retired during the financial year 1967/68 please ring the appropriate number below, and return this questionnaire in the envelope provided.

Retired 1

Partially retired 2

4. If you were working outside the United Kingdom (see note below) during all or part of the financial year 1967/68, (other than attending conferences or paying visits in connection with your work), please ring the number 1 below, and write in how much time you spent abroad during the year.

Worked abroad 1

Time abroad during year .....

'Working outside the United Kingdom' means being in more or less regular employment or in practice during the year in another country. If you were employed by a firm in the U.K. but were working overseas, this question will apply to you if you were paid an overseas salary; but it will not apply if you remained on your U.K. salary with or without special expense allowances.

The United Kingdom is England, Scotland, Wales and Northern Ireland, but not the Irish Republic.

PART II QUALIFICATIONS AND TRAINING

5. Please list below your professional qualifications with major branches or subjects (certificates, diplomas, degrees, etc.). If you have an honours degree, please enter the class you obtained in the column headed 'Class'.

Qualification	Main subject	Class	Where obtained

6. This question is concerned with post-experience training—with any training courses you may have taken *during the last twelve months.* If a course overlapped the beginning or the end of the period of the last twelve months, please give its full length and not merely the portion of it that fell within the period.

Courses may have been taken within your own company or outside it, and may have been full-time or part-time.

Please tick at the appropriate points below for any such courses you have taken in the last twelve months.

If you have taken two or more courses that fit into the same category below, please write the number of them instead of putting a tick. Thus if you took, say, an 8-week part-time course in Spanish and also a 10-week part-time course in German, you would write 'Two' on the line for 7-10 weeks part-time in the column headed Foreign Languages.

	Advanced study in own specialism	Other special technical skills (e.g. computers)	Foreign languages	Business studies (including management)
Year course full-time	4	D	M	V
part-time	8	H	R	Z
7-10 weeks full-time	3	C	L	U
part-time	7	G	Q	Y
2-6 weeks full-time	2	B	K	T
part-time	6	F	P	X
One week full-time	1	A	J	S
part-time	5	E	N	W

PART III EMPLOYMENT

The questions in this Part have two sets of code letters or numbers side by side. The first set is for answers concerning your present main employment: *please ring only one Main letter*. The second set is for any secondary occupation or occupations you may have (for example lecturing).

		Main	*Secondary*
7.	If you are self-employed, please ring the letter A here	A	1A
	If you are a salaried employee, please indicate by ringing the appropriate letter the category into which your employer falls		
	Central Government (other than the Armed Forces and the GPO)	B	2B
	The Armed Forces	C	3C
	Local Authority, (this includes technical or training colleges, polytechnics and schools which are under a Local Authority)	D	4D
	Nationalized industry (but not UKAEA), the GPO or public corporation (for example, BBC, NPA etc.)	E	5E
	The UK Atomic Energy Authority	F	6F
	University or college of advanced technology	G	7G
	Industrial or commercial company, or private firm	H	8H
	A firm of consultants	K	9K
	Any other employer (please specify)	L	10L

The next question deals with WHERE you are now working—with your FIELD OF WORK.

The list provided has been worked out with care, but also with the realization that in a profession as varied as engineering no list can be entirely satisfactory. The appropriate classification for some engineers may not be easy to decide, but the examples given here may help.

If you cannot find an exact fit for your field of work, please choose the one that comes nearest to it and ring the corresponding number or letter, but *please do not ring more than one number or letter in the Main column.*

EXAMPLES

An engineer concerned with instrumentation and control in, say, a chemical plant should ring 2—'In chemical or allied manufacture'.

A Borough Engineer or County Surveyor etc. should ring K—'In municipal engineering'.

A ship's engineer should ring H—'In transport (by rail, road, air, water)'.

An engineer in the research laboratory of, say, an aero-engine factory should ring A—'In aircraft or aero-engine manufacture', not N. But a Civil Service engineer working in a Government research Institution or Station should ring N—'In a research institution, association or station', and not S—'In Central Government administration'.

A consultant or a partner in a firm of consultants or an engineer employed by a consultant should ring M—'In a consulting firm' even though his actual work now is in the factory etc. of a client.

An engineer employed by, say, a firm of civil engineers or a contractor, and now engaged in contract work for, say, a Gas Board should ring D—'In construction (building, civil engineering, contracting)' and not E—'In gas production or distribution'.

8. Please ring the appropriate number or letter below for where you are working now.

Please do not ring more than one Main classification—the one which best fits your work.

	Main	*Secondary*
In mining or quarrying	1	1
In chemical or allied manufacture	2	2
In metal manufacture	3	3
In machine tools manufacture	4	4
In industrial plant or steelwork manufacture	5	5
In other mechanical engineering	6	6
In electrical machinery or equipment manufacture	7	7
In electronic or telecommunications apparatus manufacture	8	8
In shipbuilding or marine engineering	9	9
In aircraft or aero-engine manufacture	A	A
In vehicle manufacture	B	B
In other manufacturing industry	C	C
In construction (building, civil engineering, contracting)	D	D
In gas production or distribution	E	E
In electricity generating or distribution	F	F
In water supply	G	G
In transport (by rail, road, air, water)	H	H
In docks, harbours, inland waterways	J	J
In municipal engineering	K	K
In postal services, telecommunications or broadcasting	L	L
In a consulting firm	M	M
In a research institution, association or station	N	N
In a university or college of advanced technology	P	P
In a technical college or training college	Q	Q
In a school	R	R
In Central Government *administration*	S	S
In the Armed Forces	T	T
Other work (please specify)	U	U

.....

The next two questions, 9 and 10, are concerned with the TYPE OF WORK in which you are engaged, and provision is made for recording both main and secondary occupations. If more than one of the classifications given fits your main work, *please ring only one of them*—the one which is most important in your work.

9. If you hold an administrative or managerial position *because* you are an engineer, you will fall into category *a* below; but if you hold it *not because* you are an engineer, you will fall into category *b*. Please ring the appropriate number.

	Main	*Secondary*
a. Administrative or managerial position *as an engineer*	1	1
b. Administrative or managerial position *not as an engineer*	2	2
c. Not in administrative or managerial position	3	3

10. Please ring the letters below corresponding to the type of work in which you are engaged in your main occupation and in any secondary occupation or occupations. If, for your main occupation, more than one type of work is appropriate, *please ring only one letter*—the one which is the most important.

	Main	*Secondary*
General technical administration	A	A
Production	B	B
Instrumentation and control	C	C
Construction, installation	D	D
Research and development (but not if part of a teaching appointment)	E	E
Design	F	F
Teaching	G	G
If your teaching involves research as well, please state the percentage of your time spent on research .....%	H	H
Commercial	J	J
Consultancy not covered in one of the categories above	K	K
Other engineering	L	L
Not engineering occupation, unless covered by *b* above (please specify)	M	M

The last category (Not engineering occupation) is for any occupation outside the engineering profession—for example, teaching non-engineering subjects.

11. Do not answer this question if you are in an educational institution, in central or local government, or in the Armed Forces.

Please indicate by ringing the appropriate number below, the number of employees (including the partners or directors of a firm or company) in the 'works', site or other place of work in which you are employed now.

9 or fewer	1
10 to 49	2
50 to 99	3
100 to 199	4
200 to 499	5
500 to 999	6
1000 to 1999	7
2000 or more	8

PART IV INCOME

12. Please enter here your gross earned income for the financial year 1967/68 (see note below for the figure which is required).

Income from main occupation ..... £.....

Income from secondary occupation (if any) ..... £.....

The income required here is your gross income as returned for Income Tax for the year 1967/68 but excluding any unearned income and wife's income.

FOR SALARIED EMPLOYEES it is the total amount paid to you by your employer (or employers if you have a secondary engineering occupation as well as your main one). This income is shown on the tax form P60 which your employer will have given to you or will give you if you ask for it.

FOR SELF-EMPLOYED ENGINEERS it is your income for the financial year 1967/68 less expenses etc. allowed for Income Tax, but before the deduction of personal or capital or other allowances. Please note that it is not the amount on which you paid tax in 1967/68, which is your income for the previous year.

If your financial year ends at a date other than April 5, please give your income for your own financial year which ended at a date between 6 April 1967 and 5 April 1968.

13. If you were not working continuously throughout the financial year 1967/68 (for example, because of illness or unemployment) to an extent that seriously affected your income for the year, please ring the number 1 below.

Income seriously affected 1

14. If you are at present out of a post (except in the circumstances mentioned below) please state below how many weeks your unemployment has lasted

.....weeks

If you are not now out of a post but were unemployed during the year 1967/68, please state how long your unemployment lasted

.....weeks

Please do not include in your answer—

Any period you may have spent between qualifying and taking up your first post, or
any period you may have spent before taking up a post already arranged before you left your previous employment.

PART V LEVELS OF RESPONSIBILITY

The previous questions have all been concerned with matters of fact. In this Part we are concerned with a matter of judgment.

The table on page 8* has been drawn up as a guide to six levels of responsibility, and it is intended as a guide, not as a precise definition. A previous survey showed that most engineers will find it not too difficult to fit themselves into one or other of these levels, except for university and other teachers, for whom these levels are not suitable. If, therefore, you are a teacher please leave this question unanswered.

No guide can hope to fit exactly over the wide range of activities of the various kinds of professional engineering, so using the guide is a matter of deciding which level, taken as a whole, is the best fit for you.

You may possibly find yourself fitting different levels for the various divisions of the table. It is then a matter of judgment to decide which level comes nearest to fitting your work as a whole.

It is obviously important that you should read the descriptions of all the levels before making your decision.

15. When you have decided, please ring the appropriate number below

Level A	1
Level B	2
Level C	3
Level D	4
Level E	5
Level F	6
Beyond Level F	7

Please enter below how long you have been at this level of responsibility

.....

*The guide to the seven levels of responsibility is shown on pages 16 and 17 of this Report.

PART VI AREAS OF TECHNOLOGY AND SCIENCE

16. This question is concerned with the area of technology or science within which your post is found, and it recognizes that the technology of your group may be wider than that of your own post. Thus if your post is concerned with 'telemetry' within the group working on 'guided weapons', please put the code letters for guided weapons (AE) in Box 1 and for telemetry (GJ) in Box 2: a list of technologies with codes is set out below and overleaf. If your job technology and your group technology are the same, please put the same code number in both boxes.

Please enter in the boxes on the right the code letters from the list

Technology relevant to the team which you are directing or within which you are working 1

Technology relevant to the job you, yourself, are doing (which may be different from 1)... 2

If in question 10 you ringed M, 'not engineering occupation', please tick in Box 3, here..... 3

Code	
SA	Acoustics
AA	Aerodynamics
AB	Aeronautics
JE	Aero-engines—gas turbines
JF	Aero-engines—other
MA	Agriculture
JA	Agricultural engineering
AC	Airframes
BA	Air pollution
CA	Airports
SB	Astronomy
SC	Astrophysics
GA	Automation
JB	Automobiles, goods vehicles
AD	Avionics
PA	Biology
BB	Bio-chemical engineering
KA	Bio-engineering
KB	Bio-mechanics
CB	Bridges
EB	Broadcasting and transmitting
MB	Building materials
FA	Cables (electric)
GB	Calibration
MC	Ceramic technology
BC	Chemical engineering
MU	Chemicals and products
QA	Chemistry
EC	Circuits
CC	Civil engineering
MD	Clothing technology
ME	Colour (dyes and pigments)
BD	Combustion
DA	Computers
DB	Computer components

Code	
DC	Computer programs
DD	Computer systems
MF	Concretes
GC	Control systems
JC	Construction equipment
MG	Copying
BE	Corrosion
JD	Cranes
DE	Data systems
DF	Data transmission
CD	Docks, harbours
CE	Drainage
SD	Dynamics
CF	Effluents and industrial waste
FB	Electrical machinery
FD	Electric power generation—hydro-electric
FE	Electric power generation—nuclear
FF	Electric power generation—thermal
FG	Electric power transmission
EA	Electro-acoustics
BF	Electro-chemistry
FC	Electro-mechanical components
EE	Electronic components
ED	Electronics
CG	Erosion
MH	Explosives
MJ	Fires
GD	Fluidics
SB	Fluid mechanics
MK	Food technology
ML	Foundry
BG	Fuels

Code	
CH	Gas distribution
BH	Gas engineering
JG	Gas turbines—industrial and marine
JH	Gears
MM	Glass technology
AE	Guided weapons
JJ	Heating, ventilating, air conditioning
BJ	Heat transfer
CJ	Housing
HA	Hovercraft
HB	Hydrofoils
CK	Irrigation
CL	Land reclamation
SF	Lasers
NH	Laundry
MN	Leather technology
JK	Lifts
FH	Lighting
EF	Line communications
JL	Machine tools
MP	Magnetic materials
SO	Magnetism
HC	Marine engineering
EK	Mass transfer
RA	Mathematics
GE	Measuring instruments
KC	Medical electronics
MQ	Metallurgy
EO	Micro-electronics
EH	Micro-wave
LA	Mining—coal
LB	Mining—gypsum, clay, salt
LC	Mining—metalliferous
CM	Municipal engineering
LD	Natural gas wells
HD	Naval architecture
GF	Navigation aids
EJ	Noise
SH	Nuclear physics
GO	Numerical control
HE	Oceanography
LE	Oil wells
SJ	Optics
MR	Ordnance
MS	Paint technology
MT	Paper technology
MV	Pharmacy
MW	Photography
MX	Plastics
MY	Polymers
JM	Pressure vessels
MZ	Printing
JN	Process plant
JP	Pumps and compressors

Code	
LF	Quarrying
EK	Radar
EL	Radio and television
CN	Railways
JQ	Railway locomotives, rolling stock
EL	Refinery equipment and technology
JR	Refrigeration
JS	Reciprocating engines—diesel
JT	Reciprocating engines—other
CP	Roads, highways
AF	Rockets
NA	Rubber technology
OH	Servo-mechanisms
CQ	Sewerage and sewage disposal
NB	Silicates
NC	Smelting
CR	Soil mechanics or engineering
SK	Solid state
JU	Steam generation
JV	Steam turbine
ND	Steel
CS	Structures and buildings
CT	Surveying, geodesy and mapping
FJ	Switchgear
EM	Telecommunications
OJ	Telemetry
NE	Textiles
EN	Thermionics
SL	Thermodynamics
NF	Timber technology
CU	Traffic engineering
FK	Transformers
FL	Transmission—line
JW	Transmission—mechanical
JX	Tribology
CV	Water supply and purification
JY	Water turbines
NO	Welding

Other (please specify)

AND NOW, PLEASE CHECK BACK THAT YOU HAVE ANSWERED ALL THE QUESTIONS

The Survey of Professional Engineers 1968

Ministry of Technology
and the Council of Engineering
Institutions

Studies in Technological Manpower
No. 1

London 1970
Her Majesty's Stationery Office

Council of Engineering Institutions

Engineers have been orgenized professionally in seperate institutions concerned with a particular engineering specialism, although the need for closer links between the principal institutions had been recognized for a long time. A federal body was formed in 1962 which led to the establishment of the Council of Engineering Institutions under Royel Charter in 1965. The object and aims of the Council are:

'To promote and co-ordinate in the public interest the development of the science, art and practice of engineering, and for that purpose:

(i) to esteblish, uphold and advance the standards of qualification, competence end conduct of professionel engineers;

(ii) to advance the aims and objectives of its members so fer as they relate to the advancement of the science, art or prectice of engineering;

(iii) to foster relations with the Government, with national and international bodies and with the public; and to co-operete with other bodies at all levels of technical end professional competence, whose objects and purposes may be related to those of the Council;

(iv) to foster co-operetion with universities and other educational institutions;

(v) to foster co-operation between its members on matters pertaining to the science, ert or practice of engineering.'

The Charter also provides that the style or title of Chartered Engineer and the initials 'C.Eng.' may be used by fully qualified members of professional institutions. The constituent institutions ere listed on the page opposite.

Constituent Members

The Royal Aeronautical Society

The Institutions of
Chemical Engineers
Civil Engineers
Electrical Engineers
Electronic and Radio Engineers
Gas Engineers
Mechanical Engineers
Mining Engineers
Mining and Metallurgy
Municipal Engineers
Production Engineers
Structural Engineers

The Institute of
Marine Engineers

The Royal Institution of
Naval Architects

Steering Committee on the Survey of Professional Engineers 1968

Membership

Council of Engineering Institutions
Mr E S Sallers OBE (Chairman)
Professor G A Barnard
Mr B Hildraw
Mr C D Morgan
Mr L Wild

Consultant in charge
Mr C Scarborough

Ministry of Technology
Mrs J G Cox
Mr R G Fall OBE
Mr J R Bowles
Mr K W Haines

Council of Science and Technology Institutes
Mr D A Arnold

Engineers Guild Ltd
Mr J D Sampson

Preface

This report conteins the primary results of the second survey of the professionel engineer in Britein which was cerried out in 1968. As in the case of the 1966 survey, it wes e joint operation between the Ministry of Technology and the Council of Engineering Institutions, with the colleboration of the chartered engineering institutions. The plenning of the survey and the selection and presentetion of the results were undertaken by the Steering Committee on the Survey of Professionel Engineers 1968, whose members ere listed opposite. The survey was conducted by the Council's consultant, Mr Christopher Scerborough. The Steering Committee is indebted to the institution members for the high level of reeponse echieved.

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